Conquest and Conversion in Islamic Period Iberia (A.D. 711-1490):

A Bioarchaeological Approach

by

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ABSTRACT

This dissertation research employs biological distance and mortuary analyses in tandem with historical sources to investigate the degree to which conversion, as opposed to migration, contributed to the spread of Islam in southern Iberia. The dynamics of the 8th century conquest of Iberia by Muslim Arab and Berber forces from North Africa, and the subsequent 800-year period of religious, political, and social change, remain contested and poorly understood. Migration of Islamic peoples to the peninsula once was invoked as the primary vehicle of Islamic influence, but religious conversion, whether true or nominal, increasingly is regarded as a key component of those changes. This dissertation proposes that conversion, whether a prelude to or a component of Islamization, altered social group affiliations and interactions among those living in southern Iberia. Such changes in social relations and the resultant patterns of mate exchange will be recognizable by means of altered biological patterns of phenotypic variation. Through the examination of ~900 individuals from both Iberian and North African skeletal collections, this study concludes that conquest resulted in a great increase in phenotypic variability in the peninsula from the 8th-11th centuries. The data further indicate that males contributed this phenotypic variability to the samples in the Early Conquest period. Females, most frequently from Hispano-Roman Christian groups, appear to have 'intermarried' with these early conquerors and with the *Muwallads*, male Islamic converts, and are included in the early Muslim burial programs. From the 11th to the 14th centuries, the data presented here demonstrate a stasis and even a slight decrease in phenotypic variability in southern Iberia, which may be explained by endogamy among religious groups in this region.

DEDICATION

To my parents. To my husband.

Because of all that you are, I get to be all that I dream of being.

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CHAPTER 1

INTRODUCTION

In an era of conflict and war based largely on clashes between social and religious groups, the opportunity to examine past interactions among these groups, particularly the ways in which individuals confronted migration and changing social boundaries, offers new possibilities for the development of greater cross-cultural understanding. Through mortuary and biodistance analysis of individuals from southern Iberia and North Africa, this dissertation offers a contextualized examination of the nuances of migration, religious conversion, and social interaction, particularly intermarriage, during the Islamic period. While religious conversion increasingly is considered the major contributor to these changes, the dynamics and timing of these conversions remain contested and the contribution of migration to this picture is poorly understood (Barton 2015; Bulliet 1979; Epalza 1992; Guichard 1977; Zorgati 2012). Thus, the inclusion of regional data sets and comparative data from North Africa produce results that allow us to address long-standing questions regarding the mode and manner of the 'Islamization' of Iberia. This study acknowledges the personal nature of religious identity and archaeological discernment difficulties, yet proposes that mate choice and funerary ritual allow insight into the public and interpersonal ramifications of religious conversion. That is, religious conversions are hypothesized to have altered social group affiliations and interactions, changing reproductive constraints based upon social and legal implications of intermarriage and the taking of concubines, and reflected in biological patterns of phenotypic variation. Examination of these patterns through a biological distance analysis

provides the opportunity to examine religious conversion and changing social affiliations in Islamic period Iberia.

While neither metric nor nonmetric traits bear a one-to-one correspondence with an individual's genome (Konigsberg 2008), familial studies of modern humans and non-human mammals suggest that phenotypic traits provide significant insight into population structure and relatedness (*e.g.* Cheverud and Buikstra 1981a, 1981b, 1982; Grünberg 1952; Saunders and Popovich 1978; Sjøvold 1984, 1995). Further, published skeletal studies of European and African groups have demonstrated the utility of phenotypic data sets in clarifying population structure in these regions through time (*e.g.* Bernis et al. 1986; Jordana and Malgosa 2004; Lalueza Fox et al. 1996; McMillan and Boone 1999; Irish 1998a, b, 2000; Nikita et al. 2012; Zakrzewski 2011). Thus, a contextualized biological distance analysis of individuals from several pre-Islamic and Islamic period cemeteries in the modern region of Andalucía, Spain, as well as the comparison of such data to those from North Africa, presents an excellent opportunity for examination of the agents and structures involved in conversion during the Middle Ages.

Overview and Statement of Research Questions

In A.D. 711, a small force of Muslim Berbers and Arabs (reportedly ~10,000 soldiers, though likely exaggerated; Rehrmann 2003; Adams et al. 2008) from North Africa began the conquest of the Iberian Peninsula and subjugation of several million indigenous inhabitants (Glick 1979:35 estimates 7 million; Reilly 1993:57 estimates 4 million). While a segment of roughly 200,000 Visigoth Christians fled north, the remainder of the Christian, pagan, and Jewish populations came under direct Islamic

control (Glick 1979). Among these, it is estimated that Jewish peoples comprised roughly 100,000 individuals at the time of conquest, having settled in the peninsula following the defeat of Judea by Rome in A.D. 70 (Gerber 1992). During the course of the 8th century, an estimated total of 40,000 individuals, largely members of Islamic Berber tribes from North Africa, are thought to have settled in the Iberian Peninsula (Reilly 1993). These estimated figures, in which foreign settlers comprise 1% of the total population of Iberia, have contributed to heated debates regarding the mechanisms enabling the swift spread of Islamic cultural influence.

Historical accounts of the Muslim conquest of Iberia were written from highly charged ideological perspectives, and the degree to which Islamic influence in the peninsula resulted from movements of people or an influx of ideology (religion) has long been contested (Barton 2015; Bulliet 1979; Epalza 1992; Guichard 1977; Zorgati 2012). In recent decades, historical, genetic, and bioarchaeological studies have been used in an attempt to address this problem, yet their interpretations are often at odds. DNA analysis appears to indicate population admixture, suggesting intermarriage and conversion as key contributors to the spread of Islam in Iberia (Adams et al. 2008; Casas et al. 2006). Bioarchaeological data from southern Portugal and northern Spain appear to indicate some degree of movement of Muslim peoples into the peninsula (McMillan and Boone 1999; Prevedorou et al. 2013). However, the results of craniometric analysis also have been interpreted as indicating long-term genetic continuity in the peninsula (Jordana et al. 2010). Historical testimony is equally ambiguous: while there is some evidence of intermarriage, there were also socio-religious barriers to such unions (Hayes 2002; Shaw 2013). Archaeological approaches to Islamization focus upon the adoption of Islamic

material culture in stylistic and architectural changes (Carvajal 2013). Historians suggest that interactions between Christians, Jews, and Muslims during this period appear to have ranged between mutual tolerance to persecution and violence (Menocal 2002; Rehrmann 2003). Taken as a whole, these studies do indicate that migration, the expansion of the population of one area into another area (Rouse 1986), clearly occurred with Islamic conquest. However, the data also increasingly indicate that conversion to Islam played a major role in the social interactions in this period. Thus, understanding the demographic and social identity changes following conquest are more difficult and germane tasks than documenting the occurrence of migration. This dissertation explores these social interactions and addresses the tensions in historical and archaeological interpretations of the Islamic period in Iberia through an examination of the characteristics of conversion.

Muslim burials can be distinguished from Christian and Jewish burials in the medieval period by position of the body and the grave orientation, despite the absence of any burial furnishings (Insoll 1999a). Jewish burials often are set apart in separate cemeteries (Constable 2012). Yet mortuary analyses relying upon these markers of religious affiliation do not yield insight into the complex history of social interactions among these groups in this period, as they simply present an individual's identity in death. Biodistance analysis, the use of metric or nonmetric measures of skeletal morphology in the inference of genetic relatedness, provides objective data for examining mobility and subsequent intermarriage and reproduction. In addition to the published skeletal data referenced above, historical analyses suggest that these groups may be differentiated phenotypically, as each group's history prior to the Muslim period presents differing geographic origins and assimilation was uncommon (Rehrmann 2003). For

example, craniometric analyses reveal much heterogeneity in sample populations from this period, indicating the possibility of contextualized differentiation of genetic affiliation (Zakrzewski 2011). Thus, a study utilizing mortuary analysis and biodistance data in tandem, interpreted within the context of local historical sources, provides the opportunity to examine religious conversion and changing social affiliations. This project will address the assumption that conversion, as opposed to migration, was the main contributor to the spread of Islam in this period through a comparative analysis of North African and Iberian biodistance data. Further, through an examination of nuanced research scenarios and expectations, the proposed project will utilize the data collected to address the following major research questions:

- **To what degree did conversion, rather than migration, result in the sudden presence and increase of Islamic style burials in Iberia following conquest? What was the timing of conversion/migration in the peninsula, specifically in southern Iberia?**
- **What does the degree of genetic admixture and the mortuary patterning reveal about the population composition of Islamic Iberia following conquest?**
- **Were individuals in some religious or social groups more prone to conversion than others? Similarly, were segments of those groups (e.g. gender, age) more prone to conversion?**

Organization

This dissertation is organized into eleven chapters. Chapter 2 provides a brief history of the Islamic conquest of the Iberian Peninsula, as well as a critical review of the varying approaches to this period by historians. This account is by no means exhaustive, but it demonstrates the utility of the Arabic primary source material in recounting the events of this period and will serve to orient the theoretical and methodological chapters to follow. Further, Chapter 2 introduces the various theoretical approaches that have been used in studies of the spread of Islam in Iberia following conquest and concludes with a presentation of the research scenarios and expectations upon which this study is built.

Chapter 3 presents the anthropological and sociological theoretical frameworks regarding the construction of social identity that form the foundation of the research questions and interpretations presented here. These frameworks focus on the construction of social identity, emphasizing the fluidity and self-ascription of ethnic identity and the rigid, yet labile, nature of religious identity. Ethnic and religious identity, as facets of social identity, can be crystallized, altered, or renegotiated throughout the life course of an individual (Barth 1969; Emberling 1997; Jones 1997; Buckser and Glazier 2003). In this way, social identity operates within a feedback loop wherein individuals negotiate with and subsequently alter social mores (Meskell 2001). Therefore, this review calls for a study of identity that does not focus exclusively on ethnic or religious groups as static, normative entities; rather, it defines one that captures the creation and dissolution of identity as a response to various internal and external pressures (Brubaker 2004). Finally, this chapter questions the common use of ethnic and religious identities as

interchangeable and suggests examination of the role of conversion in the production of social identity in Islamic period Iberia.

In Chapter 4, these theoretical approaches and the research questions they inform are contextualized within a review of relevant historical sources and archaeological and bioarchaeological studies regarding the Islamic transition in Iberia. The study of the history and material culture of this period has long been of interest to Spanish, French and German scholars, but the biological history and social structures of this period are relatively recent avenues of research, particularly in Anglo-American scholarship (Barton 2015; Anderson and Rosser-Owen 2007). Historical primary source material for this period is limited, as much source material was lost through both intentional and accidental destruction of Arabic manuscripts in the Middle Ages (Dhanūn Tāha 1989; Imamuddīn 1953). This chapter highlights and seeks to critically evaluate historical and archaeological accounts regarding migration, conversion, and intermarriage as catalysts for change in the formation of ethnic and religious identities.

In Chapter 5, the history and utility of various methods for analyzing changes in population structure resulting from contact, conflict, and the negotiation of social identities are presented. In a brief review, this chapter presents an overview of the tenets and history of biological distance analysis, paying close attention to those methods utilized in this dissertation. Chapter 5 goes on to review the previous bioarchaeological studies of population structure among Iberian groups, which have focused largely on cranial metric (Bernis et al. 1986; Zakrzewski 2011) and nonmetric (McMillan and Boon 1999) analyses. These analyses have emphasized identifying and separating populations into major groups, often based upon a synthesis of conflated ethnic and religious

identities, in order to offer estimates of the patterns and volume of migration in this period. By studying these populations with an eye to understanding interactions at a more localized scale, and with the addition of dental metric and nonmetric variables, the biological distance analysis presented here will offer a more nuanced picture of culture contact and subsequent negotiation of social identities.

Chapter 6 presents the details of the skeletal samples and archaeological and mortuary contexts used to address the research questions outlined in this dissertation. Because the underlying framework of this project is based on the examination of regional biological diversity through time, the modern region of Andalucía, Spain, was chosen as a sampling site. From this region, permits were obtained for the study of pre-conquest Christian and Jewish individuals, conquest-period Christian, Jewish, and Islamic individuals, and post-conquest Christian, Jewish, and Islamic individuals. Additionally, the inclusion of samples of North African Islamic and Arab/Jewish individuals provides crucial comparative data.

Chapter 7 presents the data organization, collection, preparation, and analytical methods used to carry out the research described here. For each individual, a suite of cranial and dental morphological and metric data was collected and a mix of model-free and model-bound statistical approaches employed in analysis. This chapter describes the metrics and traits recorded for each sample, as well as the results of tests for normality and intra-observer error in the data sets. Further, this chapter discusses the pre-analysis treatment of the data that adjusts for potential age and sex biases and the problem of missing data points. Finally, Chapter 7 introduces the equations and parameters of the statistical analyses the results of which are presented in Chapters 8 and 9.

In Chapter 8, the results of the statistical analyses run with the craniometric and dental metric data are presented. Similarly, in Chapter 9, the results of the statistical analyses run with the cranial and dental nonmetric data are presented.

Chapter 10 returns to the research scenarios outlined in Chapter 6 and discusses the results of this study in light of the expectations outlined there. This chapter responds directly to the research questions that frame this dissertation, placing the results of the data analyses in their appropriate historical context.

Finally, in Chapter 11, this dissertation concludes with a summary of the broader impacts and intellectual merits of a contextualized bioarchaeological study of the Islamic period in Iberia. Whether formed or crystallized during migration or acculturation, ethnic and religious identities are continuously transformed. The examination of these processes in Islamic period Iberia facilitates the development of a theoretical perspective directly relevant to an improved understanding of identity formation and contemporary group interaction. In an increasingly globalized world, where conflicts among social and religious groups often result in prejudice, persecution, genocide, and war, the role of religious identity and conversion in dynamic social group interaction is a critical topic for continued research.

CHAPTER 2

A BRIEF HISTORY

In this chapter, I briefly review the details of the timeline for the Islamic conquest and rule of the Iberian Peninsula. These details are derived from primary source materials to the extent possible, and are supplemented by historical syntheses and other secondary sources. As a crucial precursor to the framing of research scenarios and expectations, I then briefly review some of the overarching perspectives from which historians have approached the issues of this time period. In particular, I review the theories that have been proposed for the timing and agents of the so-called 'Islamization' of Iberia following conquest. Using these historical reference points and syntheses as a baseline, I then develop and present the research scenarios and expectations to be examined with the data collected in this study.

The Islamic Conquest of Iberia

In the century after the death of Muhammad in A.D. 632, Islamic Arab forces swept through and conquered much of the Indus valley, Syria, Palestine, Egypt, and, with the conquest of Carthage in A.D. 698, much of North Africa (Chejne 1974; Reilly 1993). During the reign of caliph al-Walīd of Damascus (A.D. 705-714) two generals, Tāriq b. Ziyād and Mūsā b. Nusary, responsible for the establishment of Arab rule in North Africa set their sights on the Iberian Peninsula (*Fath al-Andalus* n.d.; Ibn al-Qūtīya 977/1975; Ibn al-Kardabūs 12th c./1986). A long history of commerce between North Africa and Spain had created an awareness of the economic and agricultural richness of the peninsula. (Dhanūn Tāha 1989; Medina Molera 1980). In April A.D. 711, Tāriq led a

large force of recently converted Berber troops from Tangier across the Straits of Gibraltar and into the Iberian interior, where he met little resistance from the Visigothic rulers, at the time caught up in political strife amongst themselves (Fletcher 1992; Glick 1979, 1995; Kennedy 1996). Upon hearing of Tāriq's quick success, Mūsā rallied an Arab force from al-Qayrawan, Tunisia, in July of A.D. 712 and joined the conquest of the peninsula (*Fath al-Andalus* n.d.; Ibn Hayyān 1076/1971).

The military ambitions of these generals purportedly exceeded the vision of the caliph in Damascus. Caliph al-Walīd was concerned about overextending his young government and more interested in maintaining control of Egypt and North Africa than in expanding across Iberia to Toledo (Dhanūn Tāha 1989; *Fath al-Andalus n.d.*). Though caliph al-Walīd recalled his generals from the peninsula, intending to control their sweeping conquest, Tāriq and Mūsā did not respond until September A.D. 714 (Ibn Habib 852/1991). By this time they had led roughly 10,000-15,000 Berber and Arab troops into Iberia (Rehrmann 2003; Adams et al. 2008). In February, A.D. 715, shortly after the return of Tāriq and Mūsā to Damascus to face their punishment, caliph al-Walīd died (Ibn al-Kardabūs 12th c./1986; Ibn al-Athir 1233/1901). His successor, caliph Umar b., appointed Al-Samh b. Malik governor of the newly acquired territory, dubbed al-Andalus, in A.D. 717 (Al-Maqqarī 1631/1840). Over the next 45 years, the Iberian Peninsula was controlled from Damascus through the succession of weak governors (Dhanūn Tāha 1989; Kennedy 1996; Reilly 1993).

With the overthrow of the Umayyad caliphs in Damascus in A.D. 750, and the establishment of the 'Abbāsīd-ruled empire re-centered in Baghdad, the Iberian Peninsula was now too far away and unimportant to concern the new dynasty (Al-Maqqarī

1631/1840; Ibn al-Athir 1233/1901). ‘Abd al-Rahman I al-Dakhil, one of the few Umayyads to escape the overthrow and massacre in A.D. 750, fled to north Africa. Upon gaining the support of Islamic Berbers, he then moved into the Iberian Peninsula in September, A.D. 755, and set up the Umayyad regime in Cordoba that would rule the region until A.D. 1031 (Al-Idrīsī 1164/1982; Scales 1994). Under the Umayyad Caliphate, agriculture and commerce flourished in the peninsula, as did the development of Islamic architecture, writing, and law (Safran 2000). Historians refer to the Umayyad caliphate when they recount the ‘Golden Age’ of Islamic Iberia and the flourishing of Islamic culture in the peninsula (Dodds et al. 2008; Kennedy 1996; Lowney 2005). However, it is also this period to which historians refer in discussions of the development of tense ethnic and religious relationships among the Visigothic Christians, Sephardic Jews, and Muslim conquerors (Christys 2002; Larsson 2003).

As the power of the emirate of Cordoba weakened at the dawn of the 11th century, and remnant Visgothic Christian kingdoms from the north put pressure on the borders, the governing authority in the peninsula began to fracture (Ibn Idhārī 1312/1948; Ibn al-Khatīb 1374/1956). With the abolition of the caliphate of Cordoba in A.D. 1031, fragmentation resulted in the formation of *taifa* kingdoms (A.D. 1031-1085), small states ruled by dynasties of local families and centered in major cities across the peninsula (Glick 1979; Wasserstein 1985). As these kingdoms feuded amongst themselves over the next fifty years, Christian forces from the north continued to put pressure on *taifa* kings and their borders (Ibn Idhārī 1312/1948; Lacarra 1963). The small armed forces of the individual *taifa* kings, made weaker by internal warfare among these fragmented states, allowed Christian forces led by Alfonso to besiege and take control of Toldeo in May,

A.D. 1085 (Kennedy 1996; Wasserstein 1985). It soon became apparent to the *taifa* kings that Alfonso and his troops had their sights set beyond Toledo, forcing them to seek military aid from Islamic Berbers in North Africa (‘Abd Allāh al-Ziri 1090/1986; Ibn al-Kardabūs 12th c./1986).

The Almoravid Empire responded to these pleas and sent troops to take control of the crumbling Islamic state (Altschul 2009; Ibn al-Athir 1233/1901). The Almoravids established a ruling regime in al-Andalus, met with support among local Berber Muslims and only minor resistance from taifa kings (Ibn al-Khatīb 1374/1956; Kennedy 1996; Lagadère 1989). The Islamic doctrines to which the Almoravid rulers subscribed were of a much stricter legal interpretation of the Quran, resulting in religious persecution and conversions of an intensity that had not yet been seen under Islamic rule in Iberia (Reilly 1992; Wasserstein 1985). This, despite the fact that the influx of Almoravids is thought to have been little more than a few thousand troops and a small number of elite rulers (Kennedy 1996; Molina Lopez 1998). Overstretched and facing Almohad pressure in Morrocco, the Almoravid regime grew weak (Codera and Zaidin 1899). Due to further fragmentation, a second phase of *taifa* kingdoms emerged between A.D. 1144 and 1147 (Guichard 1979; Ibn al-Khatīb 1374/1956). By A.D. 1172, facing continued pressure from the rising Almohad forces in North Africa, the *taifa* kings succumbed to the establishment of a centralized Almohad regime in Seville (Glick 1979; Kennedy 1996; Tourneau 1969).

The Almohad caliphate established in Seville faced several decades of increased hostility from Christian forces in the north (Jayyusi 1992; Kennedy 1996; Viguera Molins 1992). Seville fell to the Christians in A.D. 1228. The peninsula transitioned into 20 years

of chaotic raiding and a lack of unity in defense against the northern kingdoms, resulting in steady progress for the Christian kingdoms in their quest to reconquer the Iberian Peninsula (Chejne 1974). The establishment of the Islamic kingdom of Granada in A.D. 1232 provided some stability, including sustainable borders, to the Muslim presence in Iberia, but the Christian kingdoms continued to mobilize armies for the *reconquista* of the entire peninsula (Al-Maqqarī 1631/1840; Glick 2005). With the fall of Granada in A.D. 1492, Muslim rule came to an end in the Iberian Peninsula.

Historical Approaches to Islamic Conquest

Historical approaches to the study of Islamic conquest and rule typically can be linked to one of three general, overarching themes. In the first of these interpretive themes, this period is deemed one of relative unimportance; at most, the momentary interaction with foreigners that presents a bump in the otherwise smooth trajectory of cultural development in the history of Spain (e.g. Menéndez Pidal 1956; Olague 1974; Simonet 1897-1903). These authors suggest that Islamic Berber and Arab peoples moving into the peninsula had little lasting influence and minimal interaction with indigenous peoples (e.g. Sanchez-Albornez 1976). Considering the tumultuous history of variable occupation outlined above, this perspective appears fundamentally flawed. A slightly altered version of this approach views the Islamic conquest as disruptive to Iberian cultural development. From this perspective, the conquest was a curse from God, halting the flow of progress in a developing Christian society (e.g. Fernandez Morera 2011; Kagan 1995; Pidal 1929). In these studies, the social identity of Spain is tied to the remnant Visigothic Christians from the north, whose *reconquista* would restore the

peninsula and place the peninsula back on its previous track toward a modern Spanish identity. The regime of General Francisco Franco especially embraced this notion of *reconquista* articulated by Marcelino Menedez y Pelayo (1880-1882) and his pupil Ramon Menendez Pidal (1947), wherein Catholic Spain had defended against Islamic expansion and ultimately prevailed in the creation of the modern Spanish state (Barton, 2010).

The third interpretive theme around which the history of the Islamic period in the Iberian Peninsula has been constructed encompasses those perspectives that range from neutral acknowledgement of culture contact and influence to recognition of positive, or at least fundamentally altering, contributions of Islamic rule (e.g. Castro 1954; Chejne 1974; Glick 1995; Kennedy 1996; Safran 2000; Wasserstein 1985). Many ideas within this third thematic emphasis are also related to varying notions of the interconnectedness of past and present identity in modern Spain (Baxter Wolf 2009; Glick 1979, 2005; Glick and Pi-Suyer 1969). The influence and integration of Islam and Islamic peoples in medieval Spain is interpreted according to mythical constructions of a harmonious past (Epalza 1995), or in order to examine the tripartite construction of "a distinct Spanish cultural form" (Glick and Pi-Sunyer 1969:136). In these accounts, terms such as coexistence, tolerance, and pluralism are used to describe the interactions among Christians, Jews, and Muslims in al-Andalaus. This link to Spanish nationalism and the propensity for the research arising from this perspective to homogenize these religious groups in study is problematic (Baxter Wold 2009; Zorgati 2012). Yet within these perspectives lies the possibility for framing questions of acculturation, conversion, social and ideological transition, and agricultural and political development. Though these

analyses accept varying degrees and modes of Islamic influence, they all acknowledge the possibility of plural, permeable social groups in this period. Therefore, as the topics of interest in this review are those of culture contact and the negotiation of social identities, the studies examined here largely will fall into this third thematic emphasis.

In many ways, Américo Castro's (1954) hotly debated thesis paved the way for the discussion of Islamic influence and cultural interaction in Iberia. In his volume, *The Structure of Spanish History* (1954), Castro argues that modern 'Spanish' culture cannot be understood as a fixed entity with a uniform origin. Rather, he suggests the contact among Christians, Muslims, and Jews during the Islamic period, which he terms *convivencia*, resulted in a tripartite contribution to a united Spanish identity. Historians seeking to tie Spanish origins to a glorious Visigothic Christian past met Castro's (1954, 1959) books on this subject with "vigorous, often hysterical denial" (Glick and Pi-Sunyer 1969:146). Historians also have critiqued Castro's thesis on the basis of its inability to explain acculturation or cultural diffusion as active processes in the past (Russell 1959). The notion of 'stabilized pluralism' that arose from Castro's conception of cultural diffusion pervades many historical accounts of this period, particularly in reference to the cultural peak of the Ummayad Caliphate (Dodds et al. 2008). Yet these accounts fail to recognize the mechanisms by which these plural 'blocks' maintained their distinct identities and simultaneously exchanged people, traits, and ideas. In particular, it has been argued that the notion of *convivencia* allows for oversimplification of the complexity of interfaith relations and tends toward framing these relations according to modern multiculturalism (Soifer 2009), thus "indulging in anachronism" in interpretations of the past (Barton, 2015:10).

Even prior to Castro's (1954) thesis, historians sought to elucidate the boundary-maintaining mechanisms and interactions between religious and ethnic factions in this period (Glick and Pi-Sunyer 1969; Lowney 2006; e.g. Ribera 1897). Yet it is really only in the past few decades that Spanish historians and archaeologists have reacted against the notions of *reconquista* and *convivencia* in favor of new analytical approaches to social relations in Islamic Iberia. Within Post-Franco Spanish archaeology and history, these analytical models for the development of Iberia during the Islamic period arise from diverse theoretical frameworks. Some scholars have suggested post-colonial frameworks and focus upon the perspective of the marginalized segments of the population (*e.g.* Altschul 2008). Others have suggested that social relationships in this period largely were organized by systems of reciprocal interests, creating a utilitarian *conveniencia* (*e.g.* Catlos 2001, 2004). Landscape and socioeconomic archaeology of rural settlement patterns in medieval Iberia have provided interpretations of tribal and kin group organization, hydraulic and agricultural systems, and trade in this period, offering varying perspectives on the relationship between Islamization and social and economic organization (*e.g.* Acien Almansa 1994; Barcelo 1989, 1995; Bazzana et al. 1988). Studies utilizing the notion of a 'frontier' zone, building expectations of interaction from interpretations of supposed fluidity and contact along borders, also have provided interpretations of Christian and Muslim interaction in the peninsula (Bishko 1980; MacKay 1977; Senac 2000). These new frameworks have allowed the study of interpersonal relationships in Islamic Iberia to progress, yet each has been met with some degree of critique and resistance (*see* Barton 2015).

Whether the difficulty in interpretations of the social dynamics of Islamic Iberia is due to the incredibly complex social relations of the period, or to the socio-political climate in which historians and archaeologists operate, individual social agents still do not rise from homogenous ethno-religious blocks, and transitional experiences such as religious conversion remain inadequately considered. That is, religious and ethnic identities discussed for this period typically are considered homogenous, people-less units (Insoll 1999a). Specifically, the various groups active in the Iberian Peninsula at this time are presented as 'mono' ethnic or 'mono' religious (Fuller and Francke 2001; Insoll 2005). In this way, granting Islamic influence in the peninsula means that "one might get a link between Islamic practice and material culture; mosques + Muslim burials = Islam, but the net result is an archaeology devoid of sects, gender, heresy or difference" (Insoll 2005:202). It logically follows, then, that analyses of groups presented in such a way are largely devoid of nuance and entirely devoid of social agents. In order to better understand the details of Islamic conquest and rule in Iberia and its lasting effect on the development of Western European history and culture, the interactions of diverse peoples and the ways in which they expressed and manipulated various aspects of their identities in reaction to contact and conversion must be further explored.

A very recent wave of scholarship attempts to explore social interactions in Islamic Iberia through primary source documents that describe personal interactions among individuals within religious groups (*e.g.* Barton 2015; Ingram 2012; Roth 2014; Tieszen 2013; Zorgati 2012). Of particular interest to this dissertation research, several of these historians have focused their interpretive efforts on primary source materials documenting inter-faith sex, marriage, and divorce throughout this period (*e.g.* Barton

2015). These volumes present excellent details and syntheses of Arabic primary source documents such as tax records, court cases, legal rulings, and Muslim and Christian accounts of the invasion and rule of Iberia. However, aside from the difficulty in trying to read beyond primary source biases, the scale at which conclusions are made in these historical approaches can be problematic. That is, without enough caution in interpreting these documents, individual cases can be expanded to summarize a cultural norm at any given time in the Islamic period. In this dissertation, I test several of these popular interpretations of primary source material through the analysis of regional biological data.

The Spread of Islam

Several theories have been proposed for understanding the spread of Islamic influence in Iberia in the aftermath of conquest. These theories are contested and, at times, conflicting. In this dissertation I choose to highlight the most prominent of these in forming alternative research scenarios. One theory attributes increased Islamic influence to migration of family groups from North Africa shortly after conquest, suggesting the exchange of women among Islamic, Christian, and Jewish groups was taboo at the time (Guichard 1977). Under this model, conversions are a possibility, but are not thought to contribute as significantly to the spread of Islam as the rapid growth of settling groups. Alternatively, Epalza (1992) suggests the spread of Islamic influence may be attributed to conversions occurring within a few generations after the conquest, due either to intermarriage between settling soldiers and indigenous Iberian women, or to conversions of large groups either to gain favor or to avoid the social pressures and tax penalties of the new administration. Bulliet (1979) also attributes the spread of Islamic influence

directly to conversion, yet suggests the bulk of conversions occurred in the 12th century, either due to increased social contact reaching a peak in this period, or to the establishment of the Almoravid and then the Almohad dynasties and their enforcement of strict religious laws that are said to have ‘forced’ conversions in this period. Whether nominal and *en masse* (Epalza 1992), or true and personal (Bulliet 1979; Shatzmiller 1996), conversion is recognized as a key feature of the spread of Islam in Iberia. In this vein, the proposed project suggests that interpersonal social practices, such as intermarriage, which, according to historical sources, appears to have been quite frequent (McMillan and Boone 1999; Shatzmiller 1995, 1996; Zorgati 2012), must be examined in order to understand the mode, manner, and timing of conversion to Islam.

Research Scenarios and Expectations

In order to address the scenarios outlined by these theories, this project utilizes one basic framework: The examination of phenotypic variability through time. In this way, these theories of the agents of cultural change, namely the spread of Islam, can be collapsed into two main analytical types. First, to understand the possible impact of migration in this period, this research will compare Iberian and North African phenotypic variance and extralocal gene flow through time. Second, the phenotypic variance of pre-conquest, early occupation, and late occupation Southern Iberian samples through time will be examined and possible biological affinities among religious groups and between sexes will be assessed in these temporal slices. The samples examined in this project have been divided into early and late Islamic occupation phases at the 12th century to better examine the possibility of an increase in Islamic converts in this later period. When

examining phenotypic variability through the transition from the pre-conquest to the early Islamic occupation period in Southern Iberia, there are two possible outcomes—either there is a change through time, or there is not. Here, I briefly outline interpretive expectations given either of these circumstances, acknowledging that the process may have been a complex mixture of these scenarios.

Scenario 1: Migration

In order to address the possibility that migration of family groups from North Africa resulted in the sudden increase in Islamic presence and influence in the peninsula (Guichard 1977), a baseline of phenotypic variance will be established through the comparison of Iberian and North African samples from pre-conquest and late/post occupation samples. Specifically, comparative changes in phenotypic variability in these regions across these time periods will be examined to assess whether migration occurred during the Islamic period in Iberia. Further, this project also will attempt to assess the degree of population affinity between the pre-conquest North African samples and the early occupation Islamic samples. However, while the pre-conquest North African samples will be useful for comparisons of phenotypic variance through time, due to their provenance they may not be ideal samples for comparisons of biological affinity. Thus a high degree of divergence between these samples will not necessarily rule out the possibility of Berber migration contributing to the influx of Islamic influence in this period.

Scenario 2: Early Conversions

Epalza (1992) proposed that most conversions to Islam in the Iberian Peninsula occurred shortly after the Muslim conquest. If there are no significant changes in phenotypic variability between pre-conquest Iberian and early occupation Islamic samples, then this proposal may be invoked as an explanation. If this is the case, then further analysis will be undertaken to determine whether population affinity may be observed between either the pre-conquest Christian or Jewish style burials and the early Islamic style burials, which may indicate that one of these groups converted more readily in the early stages of Islamic rule. For example, it has been proposed that Jewish groups previously marginalized under Christian rule may have converted due to the promise of socioeconomic gain (Adams et al. 2008; Dhanūn Tāha 1989).

If there is a significant change in phenotypic variability between pre-conquest Iberian and early occupation Islamic samples, subsequent analyses and the contextual interpretations will be dependent upon whether this change is an increase or decrease in genetic variability. Gene flow with genetically distinct groups would add novel alleles to the population, resulting in the expectation of increased phenotypic variability. It is possible that the conquerors came without family groups and took indigenous women as wives or concubines who were then included in the Islamic mortuary program, comprising the majority of this 'swift conversion' group (Glick 1979; Levi-Provencal 1967; Marin 2000; Shatzmiller 1996). Thus, the comparison of pre-conquest males to conquest-period males will be examined, as will a comparison of pre-conquest females to conquest-period females to try to evaluate this possibility. If variability decreases, the conquest period Islamic samples may represent the immigration of a small number of

endogamous Berber groups to the peninsula, and the comparison of early conquest samples to pre-conquest North African samples will be invoked to further explore this possibility and the above-stated migration scenario. The biological expectations and contextual interpretations for this scenario are presented in graphic form in Figure 2.1.

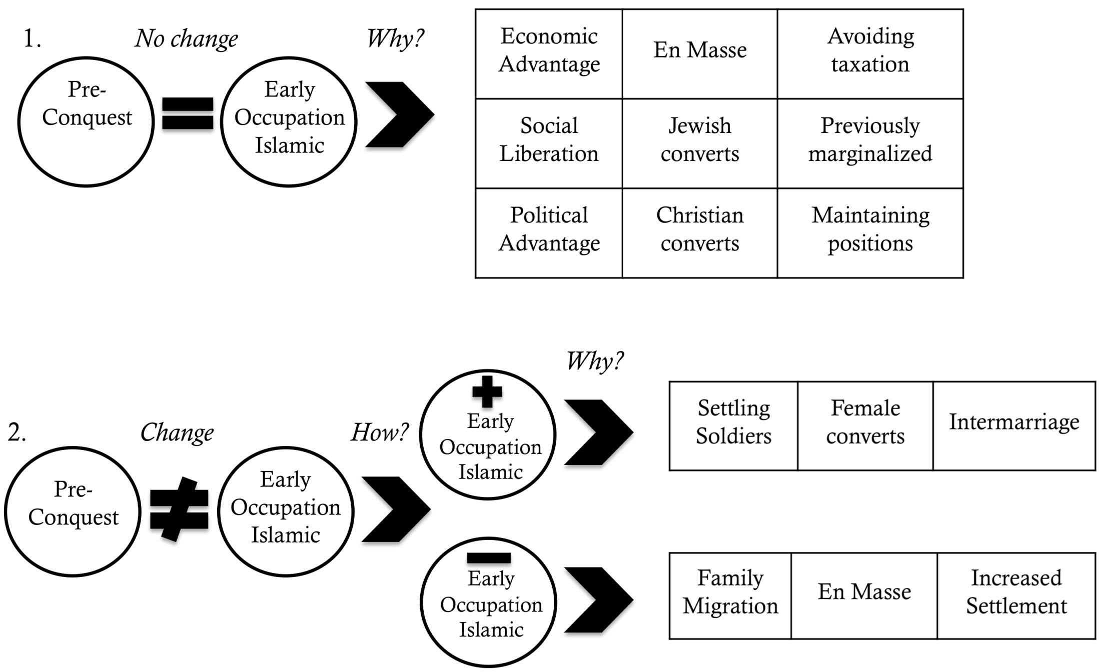

Figure 2.1 Biological expectations and contextual interpretations outlined in *Scenario 2: Early Conversions*.

Scenario 3: Late Conversions

This scenario addresses the suggestion that the conversion of Iberians to Islam following conquest was a gradual process, peaking in the 11th-12th centuries (Bulliet 1979). As with the previous scenario, there are two possible outcomes in the examination of this temporal transition—either there is a change in biological diversity through time,

or there is not. If there is no significant change in phenotypic variability between early and late occupation Islamic samples, then it is possible that endogamy among Muslims may explain this stasis. This finding would support the suggestion that the conquerors came to Iberia with their extended kin groups and intermarriage was a rarity (Guichard 1977; Nirenberg 2004).

If there is a change in phenotypic variability between early and late occupation Islamic samples, subsequent analyses and contextual interpretations will again be dependent upon whether this change is an increase or decrease in genetic variability. An increase in biological diversity would corroborate the suggestion of a sudden increase in conversions in this period (Bulliet 1979; Glick 1995), whether attributed to the stricter religious laws imposed by the Almohad and Almoravid dynasties (Shatzmiller 1996), or to the spread of Islam through interpersonal contact reaching its peak (Bulliet 1979). A decrease in biological diversity might be interpreted similarly to no change, with endogamy invoked as a possible interpretation. The biological expectations and contextual interpretations for this scenario are presented in graphic form in Figure 2.2.

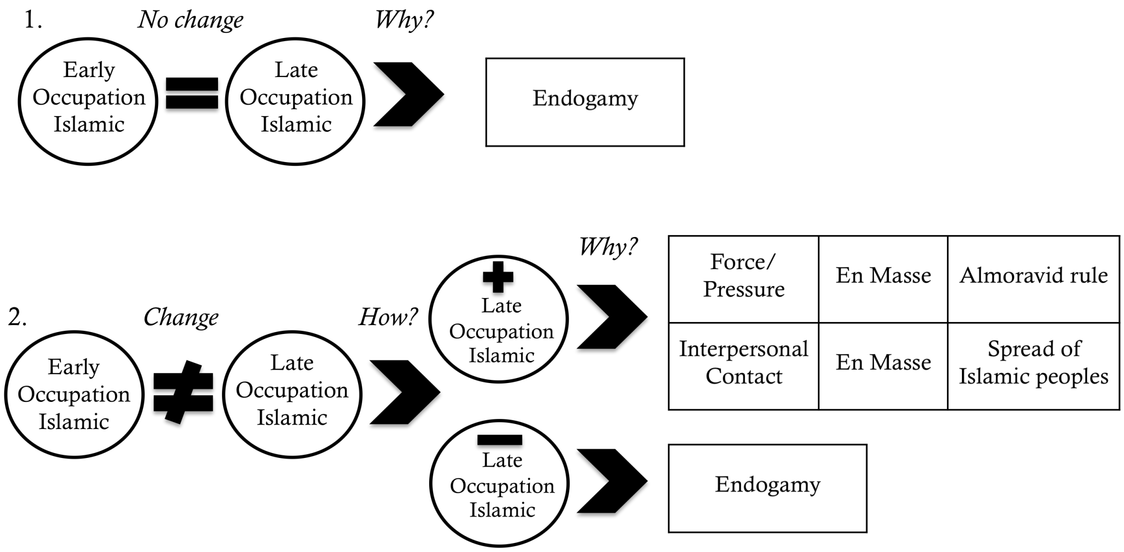

Figure 2.2 Biological expectations and contextual interpretations outlined in *Scenario 3: Late Conversions*.

Summary

The dynamics of the Islamic conquest of Iberia, presented briefly here through reference to the primary and secondary source documents and their various historical syntheses, are presented in this chapter. These historical accounts of the conquest and subsequent occupation are written from highly charged ideological perspectives, and the mechanisms enabling the swift spread of Islamic influence in the peninsula remain poorly understood. Here, I outline the necessity for bioarchaeological research that will shed light on the controversies in interpretations of this period, and develop contextualized research questions and scenarios with which to examine the dynamics of Islamic conquest. As this research involves interpretations of culture contact and change among individual agents, in the following chapter I present the theoretical foundation from which these scenarios will be explored.

CHAPTER 3

THEORETICAL FRAMEWORK

In this chapter, the theoretical framework employed to contextualize and interpret the research questions and results are summarized. I first provide an overview of the theoretical framework used in this dissertation, focusing upon its interaction with the data collected and methods used to answer the historically contextualized research questions posed in Chapter 1 and elaborated in Chapter 2. I then step back to examine anthropological and sociological approaches to identity in the past and present, and discuss the evidence for the construction of social identities in Islamic period Iberia. As this dissertation is also examining the possibility of migration as a component of the spread of Islam in Iberia, I will review the key theoretical approaches to culture contact and change utilized in anthropological and archaeological analyses of migration. Finally, I examine in more detail the main theories for the spread of Islam through both migration and conversion that were used to build the research scenarios discussed in the previous chapter.

Overview

The scenarios outlined in this dissertation are built upon the theoretical assumption that cultural and genetic exchange often is positively correlated (Schillaci et al. 2001; Nystrom 2006) and that biological patterns of phenotypic variation may be considered reflective of changes in social dynamics and group organization (Stojanowski and Schillaci 2006). In this way, biological integration may be considered an indication of interpersonal or group interaction and, more specifically, social constraints upon

reproduction (Stojanowski 2010). Here it is assumed that conversion to Islam "is not simply a residual category people fall into because there is no bishop around" (Bulliet, in Glick 1995:56), but a transition with real social and biological consequences.

Contact, conquest, and migration inevitably are disruptive to the cultural milieu (Cusick 1998). It may be expected, then, that these episodes alter the actions of individuals in ways that fundamentally alter social identities. This study recognizes identity is neither the bounded, passive result of socialization, nor the exclusive product of intentional manipulation, but a mutable, multi-dimensional aspect of an individual that is both personal and collective (Bourdieu 1977; Casella and Fowler 2005; Epstein 1978). Aspects of social identity are subject to change over time, influenced by historical, geographical, and temporal contexts (Barth 1969; Dobres and Robb 2000; Insoll 2005). The archaeological implementation of this theoretical perspective has placed emphasis on both the degree of autonomy that individuals may employ, and the flexibility of the structure within which they act and react (Silliman 2001). That is, social agents may act with individual intent and strategy, yet they are constrained by their need to operate in their own social paradigm (Giddens 1984). Individual manipulations of identities in the past, such as religious conversion or adoption of new social practices, therefore may be explored through hypotheses and scenarios based upon specific historical contexts (Barrett 2000; Hodder 1991).

As a component of social identity, religious identity is a particular challenge in interpretations of past experiences, as the observer must acknowledge the interwoven nature of religious and other aspects of identity, such as ethnicity, gender, and age (Insoll 1999a). For religious identity to be explored in past groups, it must have been perceived

as religious at the time in question, and as operating within a specific suite of social expectations and restrictions, which has been described as typically a characteristic of state-level religious institutions (Renfrew 1994). Past archaeological recognition of religion largely was dependent upon identification of places and elements of worship, and upon mortuary rites and contexts, *i.e.*, upon ritual, and not belief (Alexander 1979). Even when religious identity is archaeologically recognizable as a structuring element, it is discussed in normative terms, juxtaposed with unorthodox practices (Buckser and Glazier 2003; Insoll 1999b, 2001). Further, while religion surely exists and may be recognized in archaeological contexts outside a state-level society, the difficulty lies in interpreting religious identity and behavior among individuals in past populations. Recently, there is increased interest in confronting religion and religious practices in archaeology. This resurgence perhaps is best demonstrated by the first issue of the 21st (2012) volume of the *Archaeological Papers of the American Anthropological Association,* which is dedicated to this subject. These studies provide a crucial baseline for the identification of religious practice in archaeological contexts, but they do not address moments of conversion or the attendant interpersonal interactions. Conversion, the process of altering one's religious beliefs, has the potential to offer contextualized insight into the dynamic negotiation of religious, and therefore social, identity.

Conversion, the transition from affiliation with one religious identity to another, is particularly difficult to discern in past populations (Lindenfeld and Richardson 2012; Morrison 1992). Here, I recognize the nuances involved in discussing conversion in a medieval context and argue that regardless of its nature as a personal or public, immediate or long-term, transition, religious conversion entails change in *some* aspects of

an individual's social identity and is expected to affect community interactions (Shaw 2013; Zorgati 2012). Further, in order to explore religious identity and conversion in an archaeological context, in this dissertation I propose and utilize the notion of *social conversion*. Archaeological recognition of social conversion, identified here as *the act of converting to a particular religious affiliation such that social ties are altered, practices are affected, and social boundaries shifted*, does not require knowledge or interpretations of the nature of conversion, *i.e.* "true" versus nominal alteration of personal convictions.

The research presented here acknowledges the diversity in beliefs and practices among participants in any religion at a given time and follows Talal Asad's (2009:22) suggestion that investigations of Islam, and therefore conversion to Islam, must begin with examinations of contextualized, instituted practices "into which Muslims are inducted *as* Muslims." Though at times considered a minor component of social identity, Islam supersedes and dictates the manifestations of other components of an individual's identity within some contexts, structuring a host of social roles and the expression of identities such as gender and age (Denny 1985; Insoll 1999a; Waines 1995). The proposed research suggests that social conversions may be identified through observation of altered mortuary practice and interpersonal affiliations such as intermarriage. In this way, a study of social conversion allows insight into the movement and adoption of religious beliefs through an examination of the permeability and movement of cultural boundaries. These concepts will be discussed in more detail in the following sections.

Anthropological and Sociological Approaches to Identity

In order to explore changing aspects of social identity and interpersonal relationships through bioarchaeological analysis, social identity must be defined within a theoretical framework that allows the examination of both structure and agency in past contexts. In this section, I will define and discuss social identity, including religious and ethnic identities, as well as their transformation through conversion and ethnogenesis. I will then discuss migration and acculturation as they have been employed in the study of culture contact and change. Finally, I will place this discussion within the context of Islamic Iberia.

Social Identity

Identity is neither the bounded, passive result of socialization, nor the exclusive product of intentional manipulation, but a mutable, multi-dimensional aspect of an individual that is both personal and collective (Barth 1969; Bourdieu 1977; Emberling 1997; Jones 1997; Buckser and Glazier 2003). Individuals are engaged actively in the formation of structure in their world through their expression of various facets of social identity (Bourdieu 1977; Giddens 1984; Silliman 2001). Social identity, therefore, may be conceived of as a constant integration of various diverse parts (Epstein 1978). In this way, social identities may be multiple, both in specific temporal moments for individuals, as well as throughout an individual's lifetime. These identities have the capacity to convey altered meanings through time (Casella and Fowler 2005). For example, one may be considered an adult male Islamic Arab at a given point in his life, and through conversion later may be considered an adult male Christian Arab, an identity that

encompasses both continuous and fundamentally altered components. Further, the significance of this transition is altered depending upon the historical, geographical, or temporal context (Barth 1969; Dobres and Robb 2000; Insoll 2005). In this way, social identity is multi-faceted and complicated, yet is a result of structured components and their culturally specific associated signifiers. Therefore, though we may think of social identity in terms of its construction and transmission by active agents in specific contexts (Bourdieu 1977), it is important to consider the structure we inhabit in these contexts and its role in producing the atmosphere through which we view the world (Giddens 1984). The transmission of variable cultural traits contributes directly to the perpetuation of this structure and allows changes to be made in its expression.

The notion of cultural transmission, as it relates to both the human ability to replicate social behaviors and as an impetus for local homogeneity, refers to the human cognitive ability for teaching, learning, imitation, and pooling of cognitive resources in a cumulative fashion (Boyd and Richerson 1982). Differentiation in varying environments has been explained in terms of the interplay between that environment and the learning and developmental processes of individuals (Richerson and Boyd 2005). This capacity for culture, and the ease with which individuals can identify with both static notions of cultural traits and the fluidity of changing social identities, allows for the phenomena of the construction and alteration of social identities to occur. In this way, it may be assumed in archaeological research that individuals, not cultures, interact in any given context (Renfrew 1972). Participants in a given cultural context may be understood as individuals sharing and manipulating a similar structured distribution of resources (Schortman and Urban 1998). Through the development of an approach that examines

both this structure and the role of individuals in negotiating social identities that interact with and alter historical and social circumstances, archaeologists can recognize and examine the manifestations of changing social identities (Dobres and Robb 2000; Knudson and Stojanowski 2009).

The archaeological implementation of this theoretical framework has placed varied emphases on both the degree of autonomy that individual actors may employ and the flexibility of the structure within which they act and react (Butler 1993; Silliman 2001). That is, social agents may act with individual intent and strategy, yet they are constrained by their need to operate in their own social paradigm (Giddens 1984). On one end of the analysis spectrum, social agents are assumed to act strategically in order to advance personal interest (Blanton et al. 1996; Joyce and Winter 1996). In these cases, structure is less emphasized than agency as a force for cultural transmission and change. On the other end of the spectrum, social agents are assumed to act and react to specific historical and social circumstances, which explicitly limit their choices by the rules and resources surrounding their lives and decisions (Dobres and Hoffman 1994; Hodder 1991; Johnson 1989). This framework recognizes that individual actions may be intentional and/or preconscious and emphasizes doxic practices as integral structuring elements (Bourdieu 1977; Silliman 2001). In this way, though structure may be mutable and agency is not denied, social agents are seen as individuals who "frequently organize their daily lives not around taking over a place, but around forging residence in it" (Silliman 2001:195; Scott 1985, 1990). Individual manipulations of identities in the past, such as religious conversion or adoption of new social practices, therefore may be

explored through hypotheses and scenarios based upon historical contexts (Barrett 2000; Hodder 1991).

Expanding upon this latter framework of structure and agency in the development and negotiation of social identities, archaeological analyses of facets of social identity in contextually specific situations provide insight into the complex development of, for example, gender (Gero and Conkey 1991; Gilchrist 1999) and ethnicity (Jones 1997). Culturally contextualized archaeological analyses hinge upon recognition of the influence of these identities in many ways, as gender roles, age categories, religious beliefs, and ethnic affiliations provide much of the structure with which social agents negotiate their actions (Diaz-Andreu et al. 2005; Gowland and Knusel 2009; Knudson and Stojanowski 2009). In Islamic period Iberia, religious and ethnic identities were integral components of the social and political structures governing conquest and coexistence, ranging from the legislative acts of government to the domestic acts of the rural populace. Therefore, in order to better understand the Islamic transition at a nuanced, localized level, negotiations of religious and ethnic identities at an interpersonal level must be further explored.

Religious Identity

As a component of social identity, religious identity is a particular challenge in interpretations of past experiences, as the observer must acknowledge the interwoven nature of religious and other aspects of identity, such as ethnicity, gender, and age (Insoll 1999a). Renfrew (1994) has argued that in order for religious identity to be meaningfully explored in past populations, it must have been perceived at the time in question as religious and as operating within a specific suite of social expectations and restrictions,

typically a characteristic of state-level religious institutions. While religion surely exists and may be recognized in archaeological contexts outside a state-level society, the difficulty lies in interpreting religious identity and behavior among individuals in past populations. In the context of conquest and transition, where multiple religious groups face interaction, conflict, and conversion, these interpretations face particular challenges.

In some cultural contexts, religious identity is a minor component of social identity, often arising 'seasonally' as related to calendrical or lifecourse events (Buckser and Glazier 2003). Within other contexts, religious identity supercedes and dictates the manifestations of the remaining components of an individual's identity (Waines 1995). Where religious identity structures daily activities, food choice and preparation, trade networks, mate choice, interpersonal interactions, socio-economic and political opportunities, gender roles, and social perceptions, understanding the fluidity of religious affiliation, the possibility and degree of change, and the manner in which change occurs is integral to any study of such past groups. For example, Islam, though at times considered a minor component of social identity, within some contexts dictates the manifestations of other components of an individual's identity, structuring a host of social roles and the expression of identities such as gender and age (Denny 1985; Insoll 1999a; Waines 1995).

Whether due to its complex, personal nature, or its volatile connotations, religious identity rarely is considered in archaeological studies (Aldenderfer 2012; Insoll 1999b; 2001). As genuine belief perhaps is impossible to measure for past populations, religious identity as a structuring element in archaeology often has been discussed in normative terms, juxtaposed with unorthodox practices (Buckser and Glazier 2003; Denny 1985;

Insoll 1999b, 2001). Both Durkheim's (1965) and Geertz's (1966) definitions of religion have been avoided in archaeological research in recent decades due to a lack of emphasis on individual experience and variability (Aldenderfer 2012; Renfrew 1994). Archaeological recognition of religion largely has remained dependent upon identification of places and elements of worship, and upon mortuary rites and contexts, rather than individual experience (Alexander 1979; Bradley 1998, 2005; Brück 1999; Fogelin 2007; Marcus 2006; Scarborough 1998). In cases where religious identity is discussed at this level, it is often tied to or directly conflated with other components of identity, whether or not this relationship is warranted by the context. Renfrew (1994:47) argues that this limited archaeological perspective is in many ways due to the inability to distinguish religion as a "separable field of human activity".

As noted earlier in this chapter, there appears to be a recent increase in scholarly interest in returning to and grappling with the issue of identifying religion and religious practices in archaeology (Aldenderfer 2012; Tarlow 2013). While these studies provide a crucial baseline for the identification of religious practice in archaeological contexts, they do not address moments of conversion or the attendant interpersonal interactions. Conversion, the act of altering one's religious beliefs, has the potential to offer contextualized insight into the dynamic negotiation of religious, and therefore social, identity.

Conversion

Historians in the early 20th century largely defined conversion as a turning point wherein a new or renewed religious conviction was made (*e.g.* Nock 1933). This

approach led to the development of a ‘peripety paradigm’ wherein studies of religious conversion were based on the identification of a conversion experience (Morrison 1992). In recent decades, for the historian of the medieval period, this definition has proven to be particularly flawed. Morrison (1992) argues that interpreting a conversion experience from textual evidence can result in biased or anachronistic misreading of the text. Further, the shift from one religious identity to another is marked by different experiences, and thus varied cultural and social ramifications, in different religious traditions. Studies of conversion in the past are fundamentally affected by whether the conversion experience was thought to have occurred in a spiritual dimension or a socio-political realm, whether the mark of conversion was public or personal, and whether the result of conversion was an immediate change in patterns of behavior or a life-long shift in practices and affiliations. For the historian, these variegations in the nature of conversion and its description in medieval texts pose much difficulty in ascertaining shifts in social identity and their material correlates in the past, particularly as the word conversion, itself, “comes laden with connotations rooted in Christian history that transmit their coloration on contact to materials under investigation” (Morris 1992:186).

Thus conversion, apostasy, and syncretism must all be considered in the transition from affiliation with one religious identity to another (Levtzion 1979; Lindenfeld and Richardson 2012; Stewart and Shaw 1994). In medieval studies, this transition must be considered only when highly contextualized in a given socio-cultural setting (Morrison 1992). In this regard, these concepts, which imply a linear, complete transition, increasingly are being subsumed into a singular observational category and considered as aspects of the same complex social transition (Eaton 1993; Muldoon 1979; Ortiz 1995;

Zorgati 2012). In this way, religious conversion is not considered a single transformative act, but connotes a multiplicity and mutability in religious identity over a continuum. Complete change in all aspects of an individual's social identity is not required by this framework, yet conversion does entail change in an aspect of an individual's social identity and is expected to affect community interactions and associations (Shatzmiller 1995; Shaw 2013; Zorgati 2012).

Conversion as a theoretical framework in identity studies therefore is open to the consideration of plural, fluid identities and a variety of underlying causes and effects. The mechanisms and underlying causes of conversion vary from top-down imposition to individual choice, and must be examined carefully within the historical context in question. Again, recognizing the difficulty in defining and discerning this transition in the past, in this dissertation I propose and utilize the notion of *social conversion* and attendant categorical correlates in the research and interpretation of changing religious identities in past groups. Archaeological recognition of social conversion, identified here *as the act of converting to a particular religious affiliation such that social ties are altered, practices are affected, and social boundaries shifted*, does not require knowledge or interpretations of the nature of conversion, i.e. "true" versus nominal alteration of personal convictions. Here I argue that rapid and widespread conversions to Islam in the centuries following the death of Muhammad in 632 A.D. may be recognized through changes in mortuary patterns, in particular. These social conversion may be attributed to a variety of causes, likely linked to the geographic location and the peoples involved, and therefore this review focuses on demonstrating a general framework of conversion that may be used to contextualize bioarchaeological data.

Eaton (1993) has suggested several categories of generalized circumstance in which conversion might occur. The first of these is population movement, referring either to the actual migration of people or to prolonged cultural contact. The second is that of force, where individuals are compelled to convert in moments of conquest or persecution. Conversions may also occur if economic or political advantages are associated with a particular religious affiliation, such as differing rates of taxation or financial incentives offered to a particular group (*e.g.* in Islamic Iberia, Dhanūn Tāha 1989; Rehrmann 2003). And finally, there may be conversion for the sake of social liberation, whether from previous social persecution or social disadvantage. Though more difficult to ascertain, conversions at a communal or personal level due to altered convictions or interpersonal connections must also be considered. Within these grand thematic divisions for episodes of conversion lie more specific interpersonal causes such as group instability, identification with the new religion, and intermarriage among religious groups. Close consideration of those individuals and groups converting can elucidate the permeability of cultural boundaries in the construction and maintenance of social identity by, for example, revealing differential participation and the structure of interpersonal relationships for some segment of a population. Further, knowing which segment of a population is converting at a greater rate, and in what ideological direction allows definitive answers to the elusive questions of 'why?' and 'under what circumstances?' conversion is occurring at all.

Ethnic Identity

Ethnic identity, which is fluid and dynamic, may be defined as the perception of real or imagined common lineage, whether geographic or ancestral, that results in shared social practices and material culture. Like religious identity, ethnic identity is just one facet of social identity. Ethnic identity is relational, requires differentiation of an 'us' from a 'them', and can be solidified, altered, or renegotiated throughout the lifecourse of an individual (Barth 1969; Bentley 1987; Cohen 1978; Ericksen 1991; Jones 1997; Lucy 2005). Individuals can identify with single or various ethnic identities at any one time, and these "are accompanied by and determine rights, duties, chances, expectations, forms of exclusion and conflict, and feelings of insecurity, uncertainty, and fear about, for example, stigmatization and discrimination" (Verkuyten 2005:10). The study of ethnicity should not focus exclusively on ethnic *groups*, but should encompass the ebb and flow of the creation and dissolution of ethnicity as a response to various internal and external pressures (Brass 1991; Brubaker 2004). As described above, in the context of social identity as a whole, ethnic identity operates within a feedback loop where individuals negotiate with and subsequently alter social mores (Meskell 2001).

As an avenue for the approach to changing social identities and associated practices over time, the study of ethnogenesis in a contextually specific situation impacts our understanding of social processes. Ethnogenesis may be defined as "the birthing of new cultural identities" (Voss 2008:1) or, perhaps more useful here, as one of gradual change, an "ethnomorphosis" (Kohl 1998). For the purposes of this discussion, ethnogenesis as a process can be understood as a continuum of fluid identities, ranging

from poly-ethnic alliance formation to an emergent ethnic community "that emphasizes unity and solidarity over any differences from their ethnic pasts" (Albers 1996:94).

Social identity in Islamic period Iberia

Notions of ethnic and religious identity have been the subjects of much debate in medieval history and archaeology (Curta 2007, 2011). In Islamic period Iberia, there was not a direct correlation between ethnic and religious identity (Reilly 1993; Wasserstein 1985; Glick 2005), despite the literature that commonly conflates the two elements (*e.g.* Reyment 1983; Zakrezewski 2011). Though recent research has done much to address the notions of ethnic identity and ethnogenesis in the Iberian peninsula from the Roman period to the Middle Ages (e.g. (Bruchberger, 2017; Garcia, 2011; Gillet, 2002), and inter-faith relations recently have been discussed and interpreted extensively by historians (*e.g.* Barton 2015; Zorgati 2012), conversion has not yet been adequately addressed in the context of the Islamic transition. Typically, discussion of the formation of social identities in response to some external or internal cultural stimuli is reserved for discussion of the origins of Spanish national identity (Diaz-Andreu 1996). Historical examinations of the interactions of religious groups during this period tend to focus on the cooperation, or lack thereof, among these groups in direct reference to modern ethnic and religious conflicts (Coleman 2003; Tolan 2002).

This lack of analysis is not due to a void of primary source references to the appearance of new and hybrid identities during this period. Rather, the references to *mozarabs, muwallads*, *Andalusia-Arabs, conversos* and ethnic boundaries drawn by *taifa* kings typically are subsumed under religious identities within historical and

archaeological analysis. While these identities are intricately tied to religious identities, the expression and perpetuation of ethnic differences contributed to social tensions in the peninsula. In A.D. 734, Ubayd Allah ibn al-Habhab, the Umayyad governor in Kairouan, reinstated the previously overturned heavy taxation and slave tributes on non-Arab Muslims in Iberia. In A.D. 740, Islamic Berber factions, frustrated with these policies and their inferior social, political, and economic status among Muslims in the peninsula, revolted against the Arab Umayyad dynasty (Reilly 1993; Wasserstein 1985; Glick 2005). While born out of financial disputes, the reversion of these taxes and the resulting revolt demonstrates that although "Islam claims the ideal of a universal *umma* that stands above ethnicity", this is not always the case (Tibi 2010:128). The revolt was quelled only with the arrival of 7,000 Syrian Arab soldiers in A.D. 741.

Contact and change: Acculturation and migration

The processes of ethnogenesis and conversion are just two of several possible results of contact that may produce altered aspects of social identity. In order to place these social processes within their larger theoretical frameworks, I will review briefly the notions of acculturation and migration as they have been related to culture contact and change.

Archaeologists have adapted various theoretical and methodological approaches from anthropological and sociological literature to investigate modes of culture contact and their implications for social identity construction in the past (Rice 1998). Topics such as acculturation (Bartel 1989; Glick and Pi-Sunyer 1969; Farnsworth 1989), immigration and colonization (Bartel 1980; Dyson 1985), and economic and cultural exchange

(Dietler 2010) have been pushed into the foreground in recent archaeological treatments of contact. While each of these topics and their associated theoretical framework has analytical utility in the Islamic period context, approaches to acculturation and migration in relationship to conquest will be emphasized here to outline their utility for the nuanced investigation of conversion and ethnogenesis at a localized scale.

Contact, conquest, and migration inevitably are disruptive to the cultural milieu of the parties involved (Cusick 1998). It may be expected, then, that these episodes alter the structure and actions of individuals in ways that fundamentally alter social identities. According to Schortman (1989:102), "culture contact refers to any case of protracted, direct interchanges among members of social units who do not share the same identity." The Spanish historian Julian Ribero was perhaps the first to apply this notion, that culture contact produces change, to the Islamic conquest. Ribero (1897) argued that such contact inevitably results in imitation. This argument for change through imitation was met with hostility at the time of Ribero's writing, but his application spurred interest in the results of culture contact in the Islamic period (Glick and Pi-Sunyer 1969).

These vague notions of contact and subsequent cultural exchange do not explore the nature of this shared identity, nor, aside from the suggestion of imitation (Ribero 1897), do they address the various social processes involved in exchange. The members of these 'social units' may share many facets of identity, or they may share few, and still be considered to share 'the same identity'. For example, ethnic identity may be shared while gender or religious identities vary drastically within a given context. Therefore, in order to understand the various aspects of social identity involved in a specific instance of cultural contact, the processes spurred by contact must be examined.

Acculturation

Acculturation theory has been borrowed from cultural anthropology to better address the complex archaeological implications of culture contact. Coined and developed in the mid-nineteenth century, acculturation theory began to be applied to archaeological questions in the 1960s and 1970s (Broom et al. 1954; Redfield et al. 1936; Rogers 1993; Spicer 1961). As defined by Glick and Pi-Sunyer (1969) in an Iberian context, acculturation can be constructive or destructive to the parties involved, and tends to result in a middle ground of mutual agreements and stabilized relations. In this way, acculturation "constitutes the premier catalyst for much of cultural creativity" (Glick and Pi-Sunyer 1969:140). Acculturation as a theoretical framework in archaeological applications has been criticized in recent decades (*e.g.* Zorgati 2012). Based upon the arguments that cultural exchange is not inherently bilateral and that the term acculturation implies blocks of culture, the term 'transculturation' recently has assumed visibility. Though the application of this term may be traced to an origin temporally comparable to that of 'acculturation' (Ortiz 1940), 'transculturation' has come to be associated with notions of hybridity and postcolonial approaches to history and archaeology in Western Europe (Dodds 1984; Dodds et al. 2008). Though Sahlins (1999) has heavily critiqued this adoption of alternate terminology as a "postcolonial afterologie", historians increasingly turn to hybridity and transculturation in descriptions of Islamic Iberian culture contact, arguing that doing so allows an examination of change as transformative rather than marginal (Dodds et al. 2008; Zorgati 2012). Accepting the notion that culture contact among various ethnic and religious groups in the transition to Islamic period Iberia may be framed by transcultural and hybrid social relations and resultant identities,

the underlying processes of migration, conversion, and ethnogenesis may be further explored.

Migration

Tied to acculturation theory through its principal employment in examinations of change (Adamas et al. 1978; Trigger 1989; Silliman 2005, 2009), migration as a topic of research in archaeology has been a stimulus for much debate about the varying roles of people, materials, and ideas in dispersing cultural ideologies (Burmeister 2000; Cabana 2011; Harke 2004; Trigger 1968). The popularity of migration in archaeology has waxed and waned, largely dependent upon conceptions of feasibility and appropriate methodology (Adams et al. 1978; Anthony 1990, 1997; Champion 1990; Chapman and Hamerow 1997).

Compounding these issues, the common attribution of ethnic traits to blocks of migratory groups in continental European archaeology has infused migration issues with the problem of defining ethnic groups and boundaries in Europe (Chapman and Hamerow 1997; Kristiansen 1989; Snow 1995). When conquest and settlement of a region occur in tandem, the impact of the conquering group and the resultant archaeological context may be attributed to an influx of people, or to altered social identities among the conquered. In order to tease out the degree to which these processes were in motion in a given setting, the specific historical and archaeological contexts must be considered.

Archaeological, bioarchaeological, genetic and historical studies indicate that migration, the expansion of the population of one area into another area (Rouse 1986), clearly occurred during Islamic conquest (e.g. Adams et al. 2008; Glick 1979;

Prevedorou et al. 2010; Reilly 1993). In this context, refraining from discussions of bounded groups and understanding the demographics of the migrant groups are more difficult and germane tasks than documenting the occurrence of migration. Thus in the following section, the volume, demography, and timing with which Arab and Berber peoples from the Middle East and North Africa moved into the peninsula will be explored in reference to the impact of modes of transculturation, namely conversion and the exchange of mates, whether through intermarriage or the taking of concubines.

Migration and conversion in Islamic period Iberia

As a brief review of the numbers discussed in Chapter 1, it has been proposed that in A.D. 711, Islamic Berber and Arab forces numbering 10,000 soldiers (Rehrmann 2003; Adams et al. 2008) conquered several million (Glick 1979:35 estimates 7 million; Reilly 1993:57 estimates 4 million) indigenous inhabitants of the Iberian Peninsula. While a segment of roughly 200,000 Visigoth Christian elites fled north, the remainder of the Christian, pagan, and Jewish populations came under direct Islamic control (Glick 1979). Among these, it is estimated that Jewish peoples comprised roughly 100,000 individuals at the time of conquest, having settled in the peninsula following the defeat of Judea by Rome in A.D. 70 (Gerber 1992; Torroba 1976; Medina Molera 1980; Baer 1981). Within the next century, a total of 40,000 individuals, largely members of Islamic Berber tribes from North Africa, are thought to have settled in the Iberian Peninsula (Reilly 1993). These estimated figures, wherein it is known that migration and conversion are likely both key components of cultural change, have contributed to considerable debate regarding the mechanisms enabling the swift spread of Islamic cultural influence (Bulliet

1979; Guichard 1977; Epalza 1992; Zorgati 2012). Exploring the nuances of Islamic influence in this period offers a unique context for the examination of the role of religious identity and conversion in dynamic social group interaction. The research scenarios discussed in Chapter 2 are built upon several well-accepted theories regarding the occurrence, timing and rates of migration and conversion that could have occurred with Islamic conquest and rule. These theories are critically reviewed in more detail here, as they will become crucial elements to interpreting the data analyzed in this dissertation.

Migration of Family Groups

Several theories have been proposed to understand the spread of Islamic influence in Iberia upon conquest. One attributes this influence to migration of family groups, arguing that exchange of women among Islamic, Christian, and Jewish groups was taboo at the time (Guichard 1976, 1977). Guichard's hypothesis for the mode of acculturation in the Iberian Peninsula arose primarily as a reaction to the prevailing view of the mid-twentieth century. Articulated by Claudio Sanchez-Albornez (1956), this view held that the vast majority of the indigenous population during Islamic occupation was of indigenous 'Hispano-Roman' origin, and that the small numbers of Muslims who settled in the peninsula were assimilated into this population. Guichard (1976) countered that, due to different fundamental principles of social organization in Christian and Islamic groups, assimilation of this kind would be nearly impossible. Further, he argued that both Arab and Berber ethnic principles of clan endogamy discouraged intermarriage, and that the number of immigrants from North Africa was in the hundreds of thousands, rather than the tens of thousands previously suggested (Guichard 1976). While acknowledging

that some intermarriage took place among Christians and Muslims at this time, Guichard (1977) argues that only recent converts to Islam engaged in these mixed unions. Further, he suggests the infusion of indigenous blood may be attributed to indigenous women integrated through marriage, with children identified solely as Arabs or Berbers, thereby preserving Berber and Arab bloodlines in some sense (Guichard 1977). This view has been supported by Glick (1979), who expands upon this notion of the exchange of women as a boundary-maintaining mechanism among tribal groups. In this scenario, Islamic influence is suggested to arise primarily through the movement of peoples into the peninsula and the demographic expansion of these groups upon settlement. Under this model, conversion is a possibility but it does not contribute to the spread of Islam as significantly as the rapid growth of settling groups.

Due to the archaeological and genetic evidence for the migration and settlement of Islamic peoples, whether Berber or Arab, during this period (discussed in more detail in the following chapter) Guichard's (1977) hypothesis must be considered as a possible source of structural change in the context of culture contact. However, this hypothesis does not actually reference the repercussions of culture contact, and the reach of Islamic influence in this scenario relies solely on demographic expansion of foreigners in Iberia. The possible incorporation of indigenous Iberian peoples into Islamic social spheres (including cemeteries) following conquest must be explored further through examinations of intermarriage and conversion.

Conversion of Iberian Inhabitants

The second main theory of the spread of Islamic influence attributes this spread primarily to conversion, which is argued to have increased with social contact and peaked in the tenth to eleventh centuries A.D. (Bulliet 1979). In his seminal 1979 study, Bulliet attempted to quantify the rate of conversion to Islam in the Iberian Peninsula utilizing statistical methods. Bulliet (1979:33) defines conversion as "movement from one religiously defined social community to another." This definition portrays conversion as essentially a personal choice and a true social conversion. Bulliet's (1979) conversion curve relies upon the assumption of innovation diffusion, *i.e.* conversion to Islam primarily was determined by level of exposure to Muslims. Assuming that the initial rate of Muslim settlement in Iberia was low, and that the probability of conversion increases as the probability of encountering a Muslim increases, Bulliet argues that the peak in conversion occurs in the 10^{th}-11^{th} centuries. While this model offers an approach to the mechanism and timing of conversion as it may have come about in the Islamic period, there are criticisms of his assumptions that offer grounds for the construction of an alternative approach.

Epalza (1992) offers a critique about the timing and means of conversion that Bulliet proposes during this period, arguing that the peak period of conversion to Islam occurred shortly after conquest, in the 8^{th} and 9^{th} centuries. He argues that Muslims divide conquered peoples into two main categories, People of the Book (Christians and Jews) and pagans, forcing only pagans to embrace Islam and People of the Book to follow administrative guidelines and rules (Epalza 1992). This view paints conversion as

a change brought on primarily by official stipulations, rather than by personal convictions (Epalza 1992; Christys 2002).

Neither of these theories of conversion adequately addresses nominal conversion or social conversion, wherein indigenous Iberian peoples are 'brought into the fold' of Islamic social practices resulting in burial in an Islamic tradition. While in many ways conversion to Islam involved the adoption of new social practices, as Glick (1995) has argued, the adoption of Islamic social practices should not be confused with the adoption of the Arabic language or Berber agricultural methods. Unfortunately, those theoretical approaches to Islamization that do attempt to discuss nominal conversion (*e.g.* Zorgati 2012) are left with little to establish their arguments, as the issue of true versus nominal conversion cannot be explored without conflating ethnic and religious aspects of identity. Religious and ethnic identities are intertwined in a complicated fashion in this period, yet they remain distinct facets of social identity.

When conquest affects interpersonal relations, and slavery, the taking of concubines, and inter-faith marriage are at play in addition to other means of religious conversion, the mechanisms of Islamization are further muddled in interpretation. As will be outlined in the following chapter, Guichard's (1977) assumption of the rarity of intermarriage between Christians and Muslims is not supported by the primary legal and historical sources from the Islamic period (McMillan and Boone 1999; Hayes 2004; Shatzmiller 1995, 1996; Shaw 2013; Zogati 2012). Also, the likelihood of female slaves and prisoners being incorporated into the conquering Islamic social spheres and bearing offspring in the decades following conquest is high. Additionally, the possibility of

'forced' conversions under the Almohad and Almoravid regimes in the 11th and 12th centuries further complicates this picture (Shatzmiller 1996).

Whether nominal and *en masse* (Epalza 1992), or true and personal (Bulliet 1979; Shatzmiller 1996), conversion to Islam, rather than migration, increasingly is considered the major contributor to 'Islamisation', in the Iberian peninsula in the 8th-15th centuries (Zorgati 2012). However, as demonstrated here, the mode, manner, and timing of these conversions remain contested and poorly understood. I propose that interpersonal social practices, such as intermarriage, which is suggested by primary legal and historical sources as relatively common (McMillan and Boone 1999; Shatzmiller 1995, 1996; Zorgati 2012), be further examined in order to better understand the mode, manner, and timing of conversion to Islam in this period. In order to explore the utility of these specific frameworks in this context, the primary written sources, archaeological material, and bioarchaeological analyses for Islamic Iberia are interpreted in reference to these theoretical constructs of acculturation and conversion.

Summary

This chapter provides the theoretical framework on which the research scenarios and expectations for this dissertation are based. The development and current standing of sociological and archaeological models of culture contact and exchange, particularly those involving the construction and manifestation of social identities, are explored in detail. Further, religious identity and conversion are defined within the context of the Islamic conquest of Iberia in order to provide the background necessary for interpretations of the biological data presented in this study. The major approaches to

studies of conversion in this period are also outlined in this chapter. With this theoretical framework as the basis for the construction of nuanced research questions and scenarios, the following chapter provides the historical and archaeological context for southern Iberia, and introduces the place of this dissertation in this larger body of ongoing research.

CHAPTER 4

HISTORICAL AND ARCHAEOLOGICAL CONTEXT

In this chapter, I discuss the primary source material available for the Islamic period in Iberia. I then briefly review the archaeological topics of research that have shaped the study of this period, as well as the bioarchaeological and genetic studies that contribute to this context. Throughout this review, I demonstrate the place of this dissertation study within this body of research, and discuss the opportunity for further and more nuanced research agendas in this regional and temporal context.

The Islamic transition through primary sources

One of the main complicating issues surrounding the debate over the extent of Islamic influence in the Iberian Peninsula is the primary source material for the first few centuries after conquest. This was a period of shifting, often tense relationships among the religious and ethnic factions on the peninsula, and many of these sources are written from explicitly biased perspectives. Most of the primary sources available are either Muslim chronicles from Muslim rule, or Christian sources produced in Christian Spain (Wolf 1999). Wasserstein (1985:12) argues that interpretations made primarily from these sources are plagued with “the dangers of distortion and of inaccuracy.” Nevertheless, with detailed readings and in comparison with each other, these sources elucidate the historical framework within which cultural contact occurred.

Among the primary sources available are several chronicles of the conquest written in Latin by medieval Christian authors (*Chronica Mozarabe de 754; Chronicle of*

Alfonso III; Constable 1997), medieval Arabic sources concerned with the military conquest of the peninsula and the history of the Umayyad caliphs (Al-Idrīsī 1164/1982; Al-Maqqarī 1631/1956; *Fath al-Andalus*, n.d.; Ibn al-Athīr 1233/1853; Ibn al-Kardabūs 12th c. A.D./1986; Ibn al-Khatīb 1374/1956; Ibn al-Qūtīya 977/1975; Ibn Habīb 852 /1991; Ibn Hayyān 1076/1971; Imamuddin 1953; *Una descripcion anomina de al-Andalus* 1983; Marin 2000), and the medieval legal discourses and laws themselves, whether Christian or Muslim in origin (e.g. *Siete Partidas; Kitāb al-Mi'yār*). Specifically, the *fatwās*, or legal opinions, contained within the *Kitāb al-Mi'yār* collection offer insight into the legal issues surrounding marriage, conversion, gender, and family from the ninth to the fifteenth century in North Africa and the Iberian Peninsula (Shatzmiller 1995, 1996; Zorgati 2012). Brann (1997) argues that these legal sources comprise the best evidence for ordinary interactions among the inhabitants of the Iberian Peninsula at this time, as they had the ability to shape the society in which they were composed, and now reflect that society in study. There are very few Jewish sources for this period (Rehrmann 2003). The *Sefer ha-Qabbalah* of Abraham Ibn Dā'ud, which dates to the early 12th century, deals mostly with internal religious history (Cohen 1967). The *Kitāb al-Muhādarahh wal-mudhākarah*, by Moses Ibn Ezra, dating from this same period, is primarily a history of Jewish poets (Halkin 1975).

Latin Sources

The *Chronicle of 754* is one of the earliest primary sources for the Islamic conquest and transition, and it is one of the few Christian chronicles from this period (Constable 1997). Written by a self-described Christian living in Iberia during the second

generation after the conquest, the chronicle records some details of the invasion and the establishment of the Umayyad emirate at Cordoba (Pereira 1980). The chronicler documents awareness of the Islamic movement westward along the North African coast and into Morocco during the early 8th century. According to the writer, Muslim armies met little resistance upon crossing the Straits of Gibraltar due to the "domestic fury" that afflicted the peninsula at this time (Constable 1997:34). Later Christian laws and chronicles discussing the *Reconquista* reference the Islamic period in Iberia as well as revisions of earlier laws and mandates regarding the interactions among religious and ethnic factions. The *Siete Partidas*, a comprehensive legal code formulated during the reign of Alfonso X (A.D. 1221-1284) in the Christian Iberian kingdom of Castile-Leon, was later implemented as law in post-Islamic period Spain (Burns 2001). These laws may be juxtaposed with Muslim and Jewish legislation, whether formal or informal, to elucidate social interaction in this period.

Arabic Sources

Muslim chronicles from this period were written several centuries after the initial phases of the conquest. Those of Ibn ʻIdhārī (1312) and Ibn al-Khatīb (1374), are considered the most reliable of the chronicles due to their reliance upon earlier Muslim works (Barton 2015; Kennedy 1996; Wasserstein 1985). The purported objectivity of Ibn Hayyān's chronicle, written in the late 10th century, adds a complementary source to these (Dhanūn Tāha 1989; Pellat 1962). Muslim biographical dictionaries provide another primary source material for the Islamic period in Iberia (Lewis and Holt 1962). However, these documents are primarily concerned with providing detailed accounts of

battles, rulers, genealogies, and affairs of the elite in Islamic society, and therefore offer little insight into the lives of ordinary individuals. Islamic legislation and documentation of legal cases and their resolution provide a view "beyond the smokescreen of great events to their motive causes and underlying processes" (Wasserstein 1985:13). In order to understand and utilize Islamic legislative literature, as well as to juxtapose these sanctions with the cultural sanctions of Jewish and Christian groups in this period, the main components of the literature of Islam must first be considered.

The principle writings of Islam consist of three main areas of focus represented in the Quran, the *hadith*, and the *Shari'ah*. The Quran is believed to be the word of God as revealed to Muhammad and forms the basis for Islamic faith. The *hadith* records Muhammad's words and actions and provides the example for daily living as a Muslim, acting as a handbook for religious identity. The *Shari'ah*, the law of Islam, is a manifestation of the fundamental of Islamic jurisprudence as outlined in the Quran. It has been interpreted and executed variably through time, leading to the establishment of four main legal schools (Halevi 2007; Insoll 1999a; Quesada 1996). Interpretations of Islamic law in al-Andalus were made by *muftīs*, legal experts who acted as advisors to judges (Müller 2000). The *muftīs* were unable to provide the judge with a final judgment, but were responsible for deciding which legal doctrines from the Shari'ah should be applied in a given context (Müller 2000). The written outcome of this exchange is termed a *fatwā* (Messick 1992). The *fatwā* contains two parts, the question, or 'case description', and the response of the *muftī*. The *fatwās* were then recorded and compiled into volumes by pupils of the *muftīs*, or by scribes of the court, for reference in future cases (Hallaq 1994). While it is true that all these sources are heavily male-biased (Green 2008), unlike

chronicles or biographical lists, *fatwās* reference the problems and concerns of a wider body of individuals (Shatzmiller 1995; Zorgati 2012).

The law in historical interpretations

The *fatwās* of Islamic period Iberia recently have been employed, in juxtaposition with the *Siete Partidas*, to understand the ground-level relationships among Christian, Jewish, and Muslim peoples at this time (e.g. Shatzmiller 1996; Zorgati 2012). These studies have demonstrated that issues of gender identity, property rights, inheritance, conversion, and intermarriage all may be examined at an individual level through the laws enacted and enforced in their regard. Of particular interest here, conversion documents and issues of intermarriage and inheritance are addressed in these laws (Shatzmiller 1996).

Fatwās have been considered as both normative texts (Zorgati 2012) and as reflections of true problems and concerns (Hallaq 1994; Marin 2002). The use of normative texts, such as law codes, as sources for analysis and interpretations beyond their contents must be approached with caution (Dillard 1984; Kirshner 1975; Powers 2000; Stuard 1990). Regardless of interpretation, these cases allow contextually specific interactions between past individuals to be examined in reference to the prevailing laws and opinions under which these individuals operated. This direct view into the negotiation with and alteration of structure by active agents in the past allows nuanced understanding of the ways in which social identities were affected directly by the Islamic conquest and transition.

Men, women, and inter-faith relations

Within these primary and secondary sources for the social ramifications of Islamic conquest and rule in Iberia, the roles and interactions of males and females from diverse ethnic and religious backgrounds in this period may be further examined. In her 1989 volume, *La mujer en al-Andalus: Reflejos históricos de su actividad y categonás sociales*, María J. Viguera does much to establish a baseline for information regarding the roles of women in Islamic Iberia through this source material. Celia del Moral has built upon this work by examining Arabic source material describing the life of women in the peninsula at this time (1993). While women at this time in many ways represent "minorities within minorities" (Moral 1993:37), compounding the difficulty in obtaining and interpreting sources in their regard, these studies have provided the groundwork for recent interpretations of the roles and manifestations of sex and marriage in this period.

In his 2015 volume, *Conquerors, Brides, and Concubines*, Simon Barton suggests that intermarriage between Muslim conquerors and Iberian Christian women provided a mechanism for the consolidation of authority. Legal codes written and enforced in this period appear to support the relative commonality of intermarriage (McMillan and Boone 1999; Hayes 2004; Shatzmiller 1995, 1996; Shaw 2013). Zorgati (2012) provides an example of a legal code, or *fatwā*, from this period citing the protocol for marriage between *Muwallads*, Islamic converts, and Christian women. Yohanan Friedmann's (2003) analysis of Islamic law and Quranic passages provides much evidence for the provisions for intermarriage within Islam, as well as the specific stipulations involved. Assuming, then, that there is significant evidence for intermarriage in this period, Shatzmiller (2007) examines the effects of intermarriage inheritance and property rights.

The evidence for intermarriage presented by each of these historians is from an Islamic perspective. Christian primary sources, such as the *Siete Partidas*, also reference and make provisions for cases of intermarriage (Burns 2002; Nirenberg 2000, 2004). And finally, Hayes (2002) has demonstrated Talmudic references to intermarriage in the Jewish tradition. Despite this evidence for intermarriage, the degree to which these laws were made in reaction to the occurrence, or in legislation against the occurrence, is unclear (Zorgati 2012). Further, the relative frequency of these unions has yet to be established, feeding the continued debate over the roles of migration and conversion in the spread of Islam.

For Islamic Iberia, the social construction of marriage is intertwined with the concepts of slavery and the taking of concubines in any analysis of primary and secondary source documents, and "sexual mixing" between Islamic Berbers and Arabs and indigenous women may be documented in the source material. In fact, it has been argued that the majority of encounters between these segments of society may be found within the examination of the roles of *jawārī,* slaves, and *sarārī*, concubines, in this period (Ali, 2010; Guichard, 1976; Marin, 2000). The acquisition of concubines by Muslim males as described in the Quran was regarded as a status symbol in the medieval period, but was also a common avenue to marriage and children (Barton, 2015; Phillips 2013). This relationship was regulated by legal codes dictating the role of the concubine and any children she might bear for the master, as doing so elevated her status and her rights (Marmon 1982-89; Schacht n.d.). While trade records reveal the relatively high demand for Christian women in the slave markets of Islamic Iberia (Constable 1994, 1996), it must be stated that the acquisition of female slaves did not always result in the

incorporation of these women into the Muslim social sphere, whether through conversion or through sexual relations (Phillips 2013). Thus further examination of these dynamics must be conducted with the incorporation of other forms of data.

Though these sources depict complex patterns of interpersonal relations in Islamic Iberia, from these sources several overarching conclusions may be made that are pertinent to this dissertation research. First, Guichard's (1977) assumption of the rarity of intermarriage between Christians and Muslims is not supported by the primary legal and historical sources from the Islamic period. Second, regardless of the frequency of the social institution of marriage between Muslim males and indigenous females, the likelihood of female slaves and concubines being incorporated into the conquering Islamic social spheres and bearing offspring in the decades following conquest is high.

Archaeological approaches to Islamic period Iberia

The archaeology of Islam, in the most general sense, is a relatively new and amorphous field (Insoll 1999a; Petersen 2005, 2011, 2013; Simpson 1995; Whitcomb 2004). Because of its diversity in form and practice through time and across geographic spheres, as a rising discipline, the archaeology of Islam as a whole seems nonsensical. While the presence of a Muslim community should be identifiable in the archaeological record due to certain commonalities in material culture and burial customs, the manifestations of this religious identity are diverse (Insoll 199a, Petersen 2013). Further, as explored above, religious identity is just one facet of social identity, and it is this holistic and homogenous approach that often leads to misplaced emphases or conflation of various facets of social identity and their manifestations. Despite these concerns, there

has been an increased interest in the consolidation of an 'Islamic archaeology' in the past decade, perhaps best exemplified by the April 2014 inaugural publication of the *Journal of Islamic Archaeology*. Rather than review and refer to the development of Islamic archaeology in general, the development of Islamic *Iberian* archaeology will be considered here.

Boone and Benco (1999) argue that virtually every significant study in Islamic North Africa and Iberia has been published only since 1980. Indeed, in Insoll's (1999a) oft-cited review compendium, *The Archaeology of Islam*, Iberia is not mentioned. The recent history of Spanish archaeology has contributed to the relative scarcity of archaeological research for Islamic period Iberia, as it has only been in the past 30 years that medieval archaeology has been systematically developed in Spain (Quiros Castillo 2009). Though a number of important Islamic period sites were excavated in the early 20th century, archaeology as a discipline was not emphasized during the Franco period, 1939-1975 (Diaz-Andreu 1993), and several Spanish historians rejected the notion of Islamic influence as recently as the mid-twentieth century. Though many of the excavations conducted in the peninsula have been rescue excavations and conservation interventions, in recent decades excavations carried out in both urban and rural settings have elucidated the important socio-political changes that influenced the landscape during the Islamic period in Iberia (*e.g.* Acien Almansa 1994; Gutierrez Gonazalez 2006; Vallejo Triano 2004).

Much like the archaeology of Islam in general, the early focus of medieval archaeologists in the Iberian Peninsula was primarily on Islamic art and architecture (De Meulmeester 2005; Vernoit 1997). Guichard's (1976) hypothesis of acculturation in

Islamic period Iberia, discussed above, is credited with spurring much of the archaeological interest in the archaeology of culture contact in the peninsula. Further, Bulliet's (1979) argument for conversion as the main mechanism of acculturation has provided another testable hypothesis for archaeologists. As a result, early archaeological analyses in Islamic Iberia focused upon attempting to operationalize these notions of Islamic influence through examinations of settlement patterns (Acien Almansa 1989; Bazzana et al. 1988; Boone 1994, 1996), recorded place names and site designations (Collins 1989; Epalza 1984; Glick 1995), ceramic production (Benco 1987; Gutiérrez-Lloret 1988, 1992,1996; Myers 1984), and architecture (Bazzana 1992; Boone 1993, 1994, 1996; Redman et al. 1982). Remnants of medieval villages and fortifications, particularly structure (Lopez and Bazzana 1990), agriculture and consumption patterns (Bazzana 1998, 2002; Bazzana and Poisson 1996), related irrigation and hydraulic systems (Barcelo 1989; Kirchner and Navarro 1994; (Martin Civanto 2011) and construction materials (Hammam 1999) have become the main topics for archaeological investigation in the peninsula.

Mortuary archaeology, with its emphasis on cemetery patterning and funerary ritual, has been employed uncritically in Islamic Iberia. Muslim burials can be distinguished from Christian and Jewish burials by the specific position of the body in the grave and the grave orientation, despite the absence of any burial furnishings (Insoll 1999a). Jewish burials often are set apart in separate cemeteries (Constable 2012). Yet mortuary analyses relying upon these markers of religious affiliation do not provide insight into the complex history of social interactions among these groups in this period, as they simply present an individual's identity in death. Most publications detailing the

mortuary practices of this period are published site reports (*e.g*. Acien and Torres 1995; Navarro 1985; Ponce Garcia 1997). Despite considerable ethnographic and archaeological documentation of Islamic, Christian, and Jewish funerary practices and attitudes toward death and burial (Abu-Luhghod 1993; Daniell 1998; Davies 2002; Simpson 1995), the regularity and plainness that typically characterize burials representing all three groups has often led to the conclusion that "there is little to be gained from the study of individual graves, [as] princes and paupers should be buried according to the same rites, and within the grave nothing should be found to differentiate them" (Insoll 1999a:169). Publication of Petersen's (2013) recent review chapter, *The Archaeology of Death and Burial in the Islamic World,* suggests a new interest in the mortuary practices of Islamic peoples, though he cites only one study in Iberia.

Bioarchaeological and genetic analyses of Islamic period Iberia

The mass of archaeological data for the Islamic period in Iberia includes large collections of human skeletal remains. However, if the archaeology of Islamic Iberia may be considered youthful, the bioarchaeology of this period is in its infancy (Quiros Castillo 2009). Currently, aside from the physical anthropology reports included as appendices in archaeological reports, the scant bioarchaeological literature arising from this context falls under three main categories: sexual dimorphism and markers of activity patterns in reference to gender roles (al-Oumani et al. 2004; Pomeroy and Zakrzewski 2009), diachronic variability in reference to general health and disease patterns (Jordana et al. 2010; Robles 1992), and cranial metric and nonmetric studies in reference to genetic relatedness (Bernis et al. 1986; Jordana and Malgosa 2004; Lalueza Fox et al. 1996;

McMillan and Boone 1999; Zakrzewski 2011). Biogeochemical, mitochondrial and Y-chromosome DNA analyses contribute to the literature regarding genetic relatedness and population movement (Adams et al. 2008; Bertranpetit and Cavalli-Sforza 1991; Botigue et al. 2013; Casas et al. 2006; Calafell and Bertranpetit 1994; Prevedorou et al. 2010; Zakrzewski 2011).

While these analyses offer some insight into the lives of individuals in Islamic period Iberia, they are separated largely from theoretical considerations of culture contact. Further, their interpretations are often contradictory. DNA analysis appears to indicate population admixture and the influence of conversion as key contributors to the spread of Islam in Iberia (e.g. Adams et al. 2008). However, craniometric analysis has been interpreted as indicating long-term genetic continuity in the peninsula (e.g. Jordana et al. 2010). Where migration or conversion patterns are suggested in these studies, facets of social identity are often conflated and cultural groups are discussed in homogenous terms (e.g. Casas et al. 2006; Adams et al. 2008). Intra-population differences in sexual dimorphism and markers of activity patterns are tied to gendered labor patterns associated with the proposed sequestration of Muslim and Jewish females (al-Oumani et al. 2004; Pomeroy and Zakrzewski 2009), rather than explored within a framework that considers marriage patterns between Berber and Arab forces and indigenous Iberian populations. Perhaps this is because historical analyses further obfuscate these interpretations by offering evidence, for example, of intermarriage alongside the religious and social ordinances of the period forbidding such unions (Cardaillac 1979; Hayes 2004; Levi-Provencal 1932; Shaw 2013). As the data taken as a whole increasingly indicate that conversion to Islam played a major role in the social interactions in this period (Carvajal

2013; Zorgati 2012), the apparent interpretative contradictions of the nuances of Islamisation may be addressed through a closer examination of interpersonal interactions. While the bioarchaeology of Islamic Iberia has made strides in interpreting the larger patterns of population composition, activity, and health, there is much room for further contextual analysis.

Summary

The Islamic conquest of Iberia has been the subject of much archaeological and historical research, particularly in recent decades. This chapter reviews the availability and preservation of primary source documents, as well as the archaeological and architectural remains that provide a rich context for bioarchaeological research. In this regard, the categories of primary source document typically employed in studies of the interpersonal dynamics of the Islamic conquest are introduced. The current interpretations of archaeological, historical, genetic, and bioarchaeological research in regard to the centuries in question in this study are introduced. This chapter concludes with a review of the somewhat contradictory state of current skeletal research into the social dynamics of Islamic Iberia, suggesting that a contextualized biological distance analysis offers the potential for more nuanced interpretations of changes in social and religious identities and interactions in this period. In the following chapter, I will review the history and implementation of biological distance analysis in examinations of population interactions.

CHAPTER 5

BIODISTANCE: EXPLORING MIGRATION AND MARRIAGE

To address the scenarios outlined above, this project will employ biodistance analysis to estimate phenotypic variance and biological affinities among Iberian and North African samples dating from the 3rd to the 18th centuries. In this chapter, I will review briefly the history of biological distance analysis, including several major assumptions and critiques of the method. I will differentiate between metric and nonmetric trait analyses, discuss model-free and model-bound approaches, and conclude with a discussion of the utility of biodistance analysis in the examination of temporal and sex-specific intracemetery and intercemetery variability in the Islamic Iberian context.

Biological Distance Analysis

Biological distance analysis, or biodistance, is the measurement and interpretation of relatedness or divergence between populations, or subgroups within populations, based on analysis of skeletal and dental traits. As skeletal and dental morphology are a robust proxy for genetics, analyzing metric and nonmetric cranial and dental variables offers insight into the biological affinity of a given sample (Buikstra et al. 1990; Devor 1987; Larsen 1997). Specifically, biodistance analysis uses metric or nonmetric measures of skeletal morphology in the inference of genetic relatedness and inheritance through the reconstruction of regional patterns of gene flow, genetic drift, and natural selection (Buikstra et al., 1990). While neither metric nor nonmetric traits bear an exact correspondence with an individual's genome (Houghton 1996), genetic distances calculated between populations using both phenotypic and genotypic data consistently

produce comparable results (Adachi et al. 2003; Corruccini and Shimada 2002; Shimada et al. 2004; Shinoda and Kinai 1999). Thus, through the collection and analysis of a suite of morphological features and measurements, biodistance analysis provides objective data for examining the movement of peoples and subsequent cultural interactions, such as intermarriage and the production of offspring.

As reviewed in previous chapters, the scenarios and proposed research avenues outlined in this dissertation are built upon the theoretical assumption that cultural and genetic exchange often are positively correlated (Schillaci et al. 2001; Nystrom 2006), and that biological patterns of phenotypic variation may be considered reflective of changes in social dynamics and group organization (Stojanowski and Schillaci 2006). That is, as certain metric and nonmetric aspects of skeletal and dental morphology have a basis in genetics, categorizing these variables offers insight into the genetic relatedness of a given population (Buikstra et al. 1990; Devor 1987; Larsen 1997; Sjøvold 1977). Higher rates of similarity in metric and nonmetric variables are interpreted as signaling a higher degree of relatedness (Larsen 2002). In this way, biological integration may be considered an indication of interpersonal or group interaction and, more specifically, social constraints upon reproduction (Stojanowski 2010).

The basis of biodistance analysis, the examination of relatedness between human groups through the comparison of phenotypic traits, has a long history in anthropology (Collins Cook 2006; Konigsberg 2006; Larsen 1997, 2002; Mays 2010; e.g. Hooton 1930; Hrdlička 1935a; Long 1966; Neumann 1952; Snow 1974). Intracemetery and intercemetery biological relationships typically are identified through the simultaneous analysis of multiple traits, including both metric and nonmetric categories of skeletal data

(Pietrusewsky 2008). Early biodistance studies focused largely on interregional approaches, such as identifying migration and population replacement (Konigsberg 1987; e.g. Howells 1969, 1973; Turner 1985, 1986). These interregional approaches have been criticized as being typological or taxonomic (Armelagos and Van Gerven 2003; Houghton 1996; Williams et al. 2005). Yet the argument remains that biodistance analyses have utility in the field, and have moved beyond a migrationist framework to a focus on intraregional and intrasite approaches (Stojanowski and Buikstra 2004, 2005; Stojanowski and Schillaci 2006; Relethford 2003), particularly with the incorporation of population genetic modeling in the 1980s (González-José et al. 2001, 2002; Hanihara and Ishida 2005; Konigsberg 2006; Relethford and Lees 1982; Relethford 2001, 2004a,b; Stojanowski and Schillaci 2006).

The multifactorial nature of the phenotypic traits analyzed has led to a second main critique of biodistance analysis, that growth, development, nutrition and the environment may mask underlying genetic signatures (Armelagos et al. 1982; Houghton 1996). While neither metric nor nonmetric traits bear a one-to-one correspondence with an individual's genome (Konigsberg 2000), familial studies of modern humans and non-human mammals suggest that phenotypic traits provide significant insight into population structure and relatedness (Cheverud and Buikstra 1981a, 1981b, 1982; Grünberg 1952; Saunders and Popovich 1978; Sjøvold 1984, 1995). Where genetic distances have been calculated between populations using both phenotypic and genotypic data, comparable inferences and conclusions have been reached (Adachi et al. 2003; Corruccini and Shimada 2002; Konigsberg and Ousley 1995; Shimada et al. 2004; Shinoda and Kinai 1999; Shinoda et al. 1998). Further, recent studies have demonstrated strong correlations

between phenotypic and neutral genetic variation, particularly with regard to the temporal bone (Harvati and Weaver 2006a, b; Lockwood et al. 2004, 2005; Smith 2009; Smith et al. 2007; von Cramon-Taubadel 2009). These critiques and responses will be discussed in more detail in the following sections, as I differentiate between nonmetric and metric trait data collection and discuss the arguments for model-free versus model-bound approaches to data analysis.

Metric Analysis

Metric analyses of human skeletal populations traditionally have employed linear dimensions, or indices derived from measurement, defined by craniometric or odontometric landmarks (Bass 1995; Buikstra and Ubelaker 1994; Hillson 1996; Howells 1989; Pietrusewsky 2008). The most commonly employed dental measurements are the mesiodistal and buccolingual dimensions of the crown, though similar measurements taken at the cervico-enamel junction also may be utilized (Hillson et al. 2005; Stojanowski 2005a). Like nonmetric traits, metric data have been shown to have a strong correlation with underlying genetic variation (Gonzalez-Jose et al. 2004; Relethford 2002; Roseman 2004; Roseman and Weaver 2004). Numerous studies have demonstrated a heritability component for craniometric variables (e.g. Carson 2006a; Cheverud et al. 1979, 1988; Devor 1987; Konigsberg and Ousely 1995; Sjøvold 1984; (Sparks and Jantz 2002; Susanne 1975, 1977). Several recent studies have shed more light on the complex heritability of craniofacial phenotypic variables by incorporating geometric morphometric methods in their analyses (Martinez-Abadias et al. 2012; Martinez-Abadias et al. 2009). These studies demonstrate the complexity of human craniofacial

development and the relationship between the underlying genetic model and the phenotypic expression, but maintain that there is a strong heritability component for these variables. The heritability component of odontometric variables has also been demonstrated through a number of studies (*e.g.* Corruccini and Potter 1980; Dempsey et al. 1995; Harris and Smith 1980; Potter el al. 1983; (Kieser 1990; Stojanowski 2001). Metric biodistance analyses have been employed to examine kinship (*e.g.* Adachi et al. 2003; Stojanowski 2001, 2005; Bondioli et al. 1986; Byrd and Jantz 1994; Kelley 1989), temporal michrocronology (*e.g.* Ousley and Jantz 1978; Hausman 1984), and patterns of postmarital residence (*e.g.* Hulse 1941; Schillaci and Stojanowski 2003, 2005).

The collection of a suite of morphological features across the cranium and dentition offers the best resolution for data analysis. While both cranial and dental metric and nonmetric data are analyzed in this study, the collection of dental metric data is a unique component of this dissertation, as these data have never been collected for samples in the Iberian Peninsula. Biodistance analysis based upon dental metrics, odontometrics, offers several advantages over analyses that primarily utilize craniometric or cranial nonmetric variables (after Stojanowski 2010). The dentition offers sampling sites with much better preservation and resistance to ante- and postmortem deformation and remodeling than the cranium, which serves to maximize sample sizes even in areas where preservation of skeletal material is poor (Hillson 1996). With fewer landmarks to consider, odontometric data are simpler to record than craniometric data, though inter- and intraobserver error must still be addressed (Kieser and Groeneveld 1991). In comparison to nonmetric data, metric data are more amenable to model-bound population genetics approaches (Relethford 2003; Relethford et al. 1997; Relethford and Blangero

1990). Finally, as Stojanowski has argued (2003a, b, 2010), microevolutionary changes to the dentition due to genetic mutation may be considered minimal during a short period of time. Additionally, dental heritabilities have been shown to exceed those of cranial metric and nonmetric variables (Alvesalo and Tigerstedt 1974; Townsend and Brown 1978a, b). Therefore, the variability in odontometric data may be interpreted as reflective of changes in population structure due to genetic drift and gene flow.

Nonmetric Trait Analysis

Several hundred nonmetric traits, morphological variants of a skeletal or dental feature or landmark, have been reported since the earliest recording of morphological variation in physical anthropology (Hauser and DeStefano 1989; Ossenberg 1976; Saunders 1989; Saunders and Rainy 2008; *e.g*. Hooton 1930; Hrdlička 1935a; Snow 1948). The recording and analysis of nonmetric, or discrete, traits in crania and dentition is based largely upon classification systems of morphological variance (Buikstra and Ubelaker 1994; Dahlberg 1956; Hillson 1996; Ossenberg 1970; Scott and Turner 1997; Turner et al. 1991). Saunders (1989) and Schwartz (1995) extended and refined Ossenberg's (1969) classification system to include nonmetric infracranial traits and subdivisions for major variations.

Though originally recorded solely as descriptions of form or indications of presence or absence, nonmetric trait classifications now include *hyperostotic* and *hypostatic* categories to reflect the common morphogenesis of traits (Hall 1998). Data are analyzed using trait presence or sample frequency statistics. With the recognition that there is a genetic component underlying the expression of these traits (Biggerstaff 1970;

Laughlin and Jorgensen 1956; Lundström 1963; Sjøvold 1976, 1977), nonmetric trait analysis was incorporated increasingly into biodistance studies (e.g. Buikstra 1972; Finnegan 1972; Lane and Sublett 1972; Saunders 1978; Spence 1974). These studies showed that skeletal and dental nonmetric traits could be used to examine regional migrations (Blom et al. 1998; Christensen 1998; Johnson and Lovell 1995), family and kin groups (Alt et al. 1997; Gao and Lee 1993; Spence 1996), and population history (Conner 1990; Sciulli 1990; Hanihara et al. 2003).

Nonmetric traits do not reflect Mendelian patterns of inheritance, and the genetic basis for many cranial nonmetric traits remains ambiguous (Berry 1975; Sjøvod 1984; Carson 2006b). The expression of nonmetric traits is assumed to have an underlying continuous polygenic mode of inheritance (Hauser and DeStefano 1989). Morphology of the dentition and the variable traits present are thought to represent quasi-continuous variation based on several genes (Jernvall and Thesleff 2012; Scott and Turner II 2000). The appearance and form of these traits may be influenced by other factors such as sex, age, activity, body modification, and pathology (Del Papa and Perez 2007; Hall 1998; Saunders and Rainey 2008). Further, the definitions and standards for scoring nonmetric traits have been criticized as inadequate and lacking comparative strength (Donlon 2000). In spite of these cautions, the study of intracemetery biological relationships utilizing nonmetric traits retains its utility in contextualized studies of behavioral and evolutionary processes, particularly when these traits are considered alongside metric variables (Brothwell 2000; Stojanowski and Schillaci 2006).

Model-Free versus Model-Bound Approaches

In their 1982 publication, *The Use of Genetic Traits in the Study of Human Population Structure,* Relethford and Lees brought attention to the use of population genetic frameworks in skeletal biology and distinguished between two basic approaches to the analysis of metric data sets. Model-free approaches rely on multivariate statistical methods and no specific population genetic parameters are estimated (Relethford and Lees 1982; Relethford and Blangero 1990; e.g. Green 1982; Waddle 1994). Model-free methods typically are employed to examine the relationship between trait or metric data and external factors, such as geography or linguistics (Frankenberg and Konigsberg 2011). Multivariate statistical procedures such as factor analysis, principal components analysis, discriminant function analysis, and generalized distance are common analyses employed in the metric analysis of skeletal remains (Pietrusewsky 2008). The multivariate Mahalanobis' D^2 and the C.A.B. Smith Mean Measure of Divergence (MMD) have been employed frequently in the analysis of metric and nonmetric data (Larsen 1997). Though model-free methods remain frequently employed in biodistance analysis (Pietrusewsky 2008), model-bound approaches offer several methodological advancements. As Konigsberg (2006) argues, the recent employment of direct genetic assays in the study of prehistoric skeletal remains and the return to research questions that attempt to address prehistoric migrations highlight the need for the continued use and refinement of model-bound approaches to population genetic studies.

Model-bound approaches adopt a particular population genetic framework to estimate one or more evolutionary mechanisms, such as genetic drift or gene flow (Relethford and Lees 1982; Relethford and Blangero 1990; *e.g.* Lane and Sublett 1972;

Nystrom 2006; Schillaci 2003; Tatarek and Sciulli 2000). These approaches represent the modification of the Harpending and Jenkins (1973) R-Matrix model and the Harpending and Ward (1982) model for examining extra-local gene flow (Relethford and Blangero 1990; Williams-Blangero 1989a,b; Williams-Blangero and Blangero 1989). These methods were corrected for statistical sampling bias and codified in the statistical software RMET (Relethford 1991a, 1996; Relethford et al. 1997; Relethford 2003). Of particular significance to biodistance analysis, model-bound methods allow for the estimation of regional genetic variation (F_{ST}) and interpopulation genetic distances (Relethford 2003). Although model-bound approaches were cited as infrequently employed in studies of past populations in 2008 (Pietrusewsky), in his brief 2011 review of model-bound approaches Stojanowski (2011:19) argues that "the analytical results of model-bound methods are extremely powerful and have completely supplanted multivariate statistical approaches for landmark data."

Biodistance analysis in an Islamic Iberian context

As briefly reviewed in earlier chapters, previous bioarchaeological analyses of population structure using biodistance methodology in Islamic Iberia have focused primarily upon cranial metric and nonmetric analysis to assign individuals to ethnic or religious groups. The recording of nonmetric traits, particularly rare traits, in skeletal collections is typical of skeletal addendums to Spanish site reports, but these traits are infrequently analyzed in a biodistance framework. Several early studies of the collections included in this research even utilized comparative methods that fall among those critiqued as racist, such as sorting measurements into cranial shape 'types' based on

robusticity measures (*e.g.* Souich 1969). These approaches produce inferences of group membership in religious or ethnic groups in attempts to understand migration and settlement patterns in the Mediterranean region. Yet temporal change is not considered in these analyses, nor are the underlying behavioral structures accounting for these variations. In this way, the seemingly ever-present issue of identifying and defining cultural blocks in this period is perpetuated. As outlined previously, this study assumes that conversion is a transition with real social and biological consequences. Thus the research scenarios developed here operate under the historically informed assumption that religious identity in the Islamic period influenced choice of mate, the religious identity of offspring, and the religious affiliation displayed in funerary rituals.

To explore the changes in mating network composition related to the Islamic transition in Iberia, this research employs cranial and dental metric and nonmetric data in a contextualized biodistance analysis. In order to examine the demographics of population movement and the impact of the Islamic transition on rates of intermarriage in a given region, this biodistance analysis focuses upon post-marital residence and sex-specific migration (*e.g.* Corruccini 1972; Lane and Sublet 1972; Buikstra 1980; Schillaci and Stojanowski 2003) utilizing R-matrix distances (*e.g.* Steadman 2001; Schillaci and Stojanowski 2005) and phenotypic variance in sex-specific groups (*e.g.* Stefan 1999; Tomczak and Powell 2003). In order to examine the temporal component of conversion and migration in this period, biodistance analysis focusing upon intracemetery variance (Petersen 2000; Stojanowski 2001) and temporal change is employed using univariate and multivariate analyses. In this way, biodistance analysis of contextualized research questions and hypotheses addresses the rate and timing of conversion, whether certain

groups or sub-groups were more prone to conversion than others, and explores nuanced patterns of social interaction, such as intermarriage, among religious groups in this period.

Summary

This chapter provides an overview of the development, critiques, and merits of contextualized biological distance analysis. More specifically, this chapter reviews the use and utility of model-free versus model-bound approaches in biodistance, introducing some of the methods employed in this dissertation. This chapter serves to orient the materials and methods chosen for this dissertation, which are outlined in detail in the following chapters.

CHAPTER 6

MATERIALS

In this chapter, I describe the human skeletal samples from whom data were collected for this dissertation. I begin with a brief overview and justification for the choice of samples as a whole, detailing both the samples included, as well as the total number of samples assigned to each time period of interest. I then discuss the temporal and mortuary contexts of each sample, providing information on the number of individuals excavated from each site, the burial characteristics, and the preservation of the samples.

Overview

To investigate the degree to which conversion (or migration) contributed to the rapid spread of Islamic influence in the Iberian Peninsula, as well as to elucidate patterns of conversion in southern Iberia, this research utilizes a regional approach in the selection of samples for analysis. As the basic framework of this project is based on the examination of local biological diversity through time, it is important that the selection of samples cover the same geographic range for each temporal slice examined. The conquest and occupation of southern Iberia occurred very quickly following conquest. In this region, groups of Hispano-Roman and Jewish peoples had established large settlements and cities in the centuries prior to conquest. Following conquest, Islamic style cemeteries were quickly established, and it is from this region that several of the largest Iberian Islamic cemeteries known have been excavated. Therefore I chose to focus this

research on the dynamics of conquest, conversion, and intermarriage in southern Iberia, particularly centered on a region that is now referred to as Andalucía, Spain.

The modern region of Andalucía, Spain, was conquered by Mūsā in A.D. 712 soon after his arrival in the peninsula. The cities examined here within this region were in communication during this period, and the total area covered is roughly 210KM EW and 50KM NS (Figure 6.1). Routes between each of these cities are much shorter, and existed in antiquity.

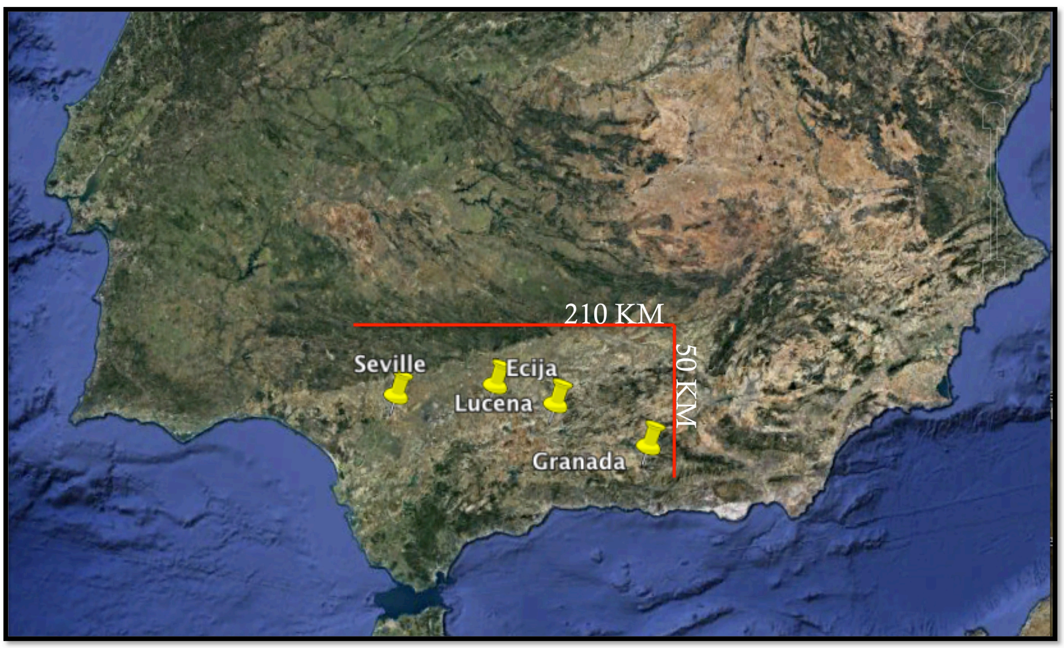

Figure 6.1 Google Earth image showing the approximate locations of the necropoli from which the individuals examined in this study were excavated (2017).

From Andalucía, permits were obtained for the study of pre-conquest Christian and Jewish individuals, conquest-period Christian, Jewish, and Islamic individuals, and post-conquest Christian, Jewish, and Islamic individuals (Table 6.1). As noted in Chapter 4, Muslim burials can be distinguished from Christian and Jewish burials by the specific position of the body in the grave and the grave orientation, and Jewish burials often are

set apart in separate cemeteries. The excavating archaeologists for the sites included in this analysis provided extensive mortuary records of the burial position, grave orientation, and other burial and cemetery characteristics providing the baseline for the ethnic and religious affiliations of the individuals included in the mortuary programs of each site. Again, review of published data in reference to these sites suggested notable phenotypic differentiation could be recorded for these groups, and similar data points were collected wherever possible to enable future comparisons (*e.g.* Bernis et al. 1986; Jordana and Malgosa 2004; Lalueza Fox et al. 1996; McMillan and Boone 1999; Irish 1998a, b, 2000; Nikita et al. 2012; Zakrzewski 2011). I test the assumption that migration does not play as large a role in the spread of Islam as conversion through comparison of these data sets with North African skeletal material. Recent DNA studies indicate that the genetic makeup of modern Northwest African peoples can be traced to Berber populations from the Pre-Islamic period (Arredi et al. 2004). Therefore, though Medieval North African skeletal material is unavailable for analysis at the present time, the inclusion of individuals from post-Islamic period collections provides crucial comparative data and represents a previously unexplored avenue of research. Additionally, published data from pre-Islamic Libyan samples will be included as additional comparative material (Nikita et al. 2012).

Table 6.1 Chronological distribution of samples included in this study.

Date	***n***	**Group**	**Site/Region**	**Housed**
1st c. B.C.	24	El Argar	Purullena	University of Granada
4th-8th c. A.D.	24	Hispano/Roman	Cerro de San Cristobal	University of Granada
4th-8th c. A.D.	63	Hispano/Roman	Cortijo Coracho	A & E Museum of Lucena, Córdoba
5th-7th c. A.D.	30	Hispano/Roman	Ecija	Museo Histórico Municipal de Écija
5th-9th c. A.D.	46	Jewish	La Buhayra	Museo Arqueológico de Sevilla
8th-12th c A.D.	101	Jewish	Ronda Sur	A & E Museum of Lucena, Córdoba
8th-11th c. A.D.	300	Muslim	Ecija	Museo Histórico Municipal de Écija
10th-14th c. A.D.	119	Muslim	La Torrecilla	University of Granada
1st-8th c. A.D.	46	Garamante	Garama, Libya	**Unknown – Published Data Used*
17th-18th c. A.D.	98	Berber	Algeria, Morocco	Musée de l'Homme, Paris
17th-18th c. A.D.	21	Bedouin Arab/Jewish	Algeria, Tunisia, Libya	Musée de l'Homme, Paris
Total Sampled	**873**			

Table 6.2 demonstrates the distribution of samples according to religious burial style and region of origin, showing the roughly equivalent sample sizes for each group in the study.

Table 6.2 Total number of individuals included per region and affiliation.

Affiliation	**Region**	***n***
Hispano/Roman	Andalucía, Spain	142
Islamic	Andalucía, Spain	419
Jewish	Andalucía, Spain	147
Garamante	Libya	46
Historic Berber	Algeria, Morocco	98
Historic Arab/Jewish	Algeria, Morocco	21

In the following section I will provide brief background information for each of the sites included in this analysis, moving from detailed discussions of the Andalucían sites to those samples derived from North African groups.

Andalucía, Spain

From Andalucía, Spain, pre-conquest Christian and Jewish individuals from the cities of Granada and Lucena, as well as conquest-period Christian, Jewish, and Islamic individuals from Granada, Lucena, Écija, and Sevilla have been examined. The chronological and geographical distribution of these samples is represented in Figure 6.2. In this section, I will discuss the context for the Andalucían sites and the available individuals from each collection, following the chronological order established in Table 6.1. Notes on the preservation status of each collection are provided.

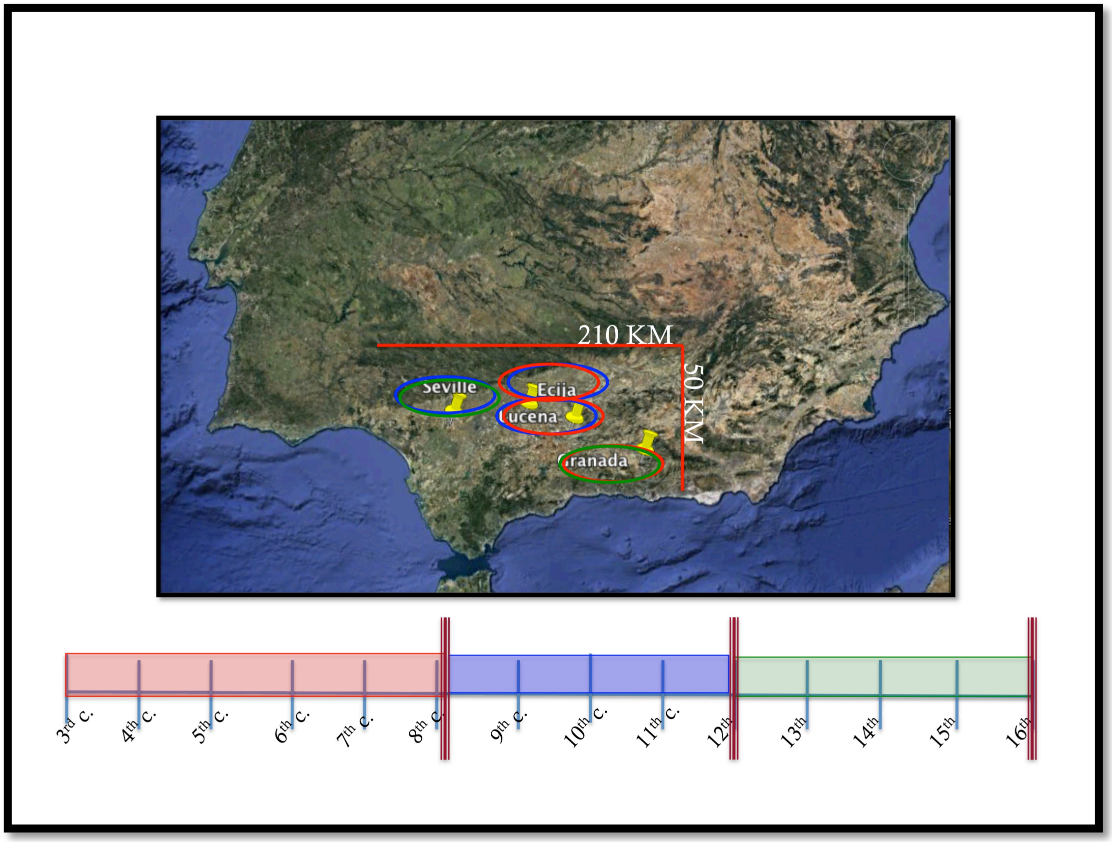

Figure 6.2 Chronological distribution and geographic area of Iberian samples included in this study (Google Maps, 2017).

Purullena

The necropolis of Cuesta del Negro, located in Purullena, Granada, Spain, is associated with the Iberian El Agrar culture of the Bronze Age and has been dated to the 1st century B.C. (Molina and Pareja 1975). The necropolis of Cuesta del Negro was excavated between 1971 and 1972 by a team from the University of Granada (Molina and Pareja 1975; Molina, 1983). From this site, 37 tombs were excavated and 25 individuals were recovered (Contreras et al. 1987-8). The remains are housed at the University of

Granada and, though poorly preserved, were adequate for the collection of dental and cranial metric and nonmetric data.

Cortijo Coracho

The necropolis from the Hispano-Roman site of Cortijo Coracho, dated to the 4th-7th centuries A.D., was excavated by a team from the Archaeological and Ethnographic Museum of Lucena, Córdoba in 2003-2009. During survey for railway construction, a basilica and funerary structures were discovered on the outskirts of the modern city of Lucena (Diéguez Ramírez 2008). Thought to be associated with a known nearby Roman settlement, approximately 89 individuals were recovered from 60 burial features at this site and are curated at the museum in Lucena. All individuals were buried in an East-West orientation, lying in a supine position with arms extended along the sides, and few grave goods were recovered (Diéguez Ramírez 2008).

Cerro de San Cristobal

The necropolis from the Hispano/Roman site of Cerro de San Cristobal in Almunecar, Granada, dated to the 4th-8th centuries A.D., was excavated in the early 1960s and the individuals recovered are currently curated at the Laboratory of Physical Anthropology, University of Granada (*personal communication*, Angela Perez Fernandez, University of Granada). Though only 45% of the necropolis could be excavated, and their burial orientations are unclear due to preservation and conservation issues, approximately 100 individuals were available for analysis (Pellicer 1962, 2007).

La Buhayra

The Jewish necropolis of La Buhayra, Sevilla, dated to the 5th-9th centuries A.D., was excavated in the 1980s and contained 40 tombs with 30 individuals, currently curated at the Museo Arqueológico de Sevilla (Bernis et al. 1986). While the preservation of these individuals is fair, sufficiently complete individuals for collection of biological distance data were included.

Ronda Sur

The history of the city of Lucena is tied intricately to that of the history of Jewish peoples in Iberia, particularly during the Islamic rule of the peninsula (Maíllo Salgado, 1993). Arab and Jewish historical sources identify Lucena as home to a significant population of Jewish individuals, including prominent scholars and tradesman. The Jewish necropolis of Ronda Sur, Lucena, radiocarbon dated to 940-1110 A.D. (Botella and Riquelme 2008), was excavated in 2007. The Archaeological and Ethnographic Museum of Lucena, Córdoba, houses approximately 201 individuals from this site. Preservation of remains was problematic in Ronda Sur due to the acidity of the soil (De Luca et al. 2011), but the dentition is well-preserved and cranial and dental nonmetric traits and dental metric traits were recorded for this population.

Écija

The medieval cemetery at Écija, dated to the 8th-11th centuries, was excavated between 1997 and 2002. Approximately 4,500 individuals were recovered from the site and are currently curated at the Museo Histórico Municipal de Écija. The majority of individuals

were buried on their right side in a North-South orientation, which is the typical Islamic style, and with no grave goods (Zakrzewski 2011). A small sub-set of individuals excavated from this site date to an earlier cemetery from the Visigothic period. Approximately 40 individuals were buried in a supine position facing East-West, typical of Christian burials from the 5th-7th centuries in this region. These early burials were placed in tombs constructed with limestone slabs (*personal communication*, Antonio Fernandez Ugalde), and the preservation of these individuals is fair to poor. The Islamic style burials appear to have been placed directly in the earth, and the preservation of these individuals is good to excellent

La Torrecilla

The medieval Muslim cemetery of La Torrecilla, dated to the 9th-14th centuries A.D., was excavated between 1968 and 1969; approximately 152 individuals were recovered from 139 graves. It appears that the necropolis was used intensively in the 9th and 10th centuries, waning in the 11th century and only sporadically used in the 12th-14th centuries, providing burial information on very early Muslim burials in the peninsula (Souich 1979). The preservation of these individuals is excellent, and they currently are curated at the Laboratory of Physical Anthropology, University of Granada. Of the 139 graves excavated, 138 contained individuals who were interred in a roughly North-South orientation on their right side, typical of Islamic burials, while a single grave contained an individual buried in a Northwest to Southeast supine position, more typical of a Christian burial (Souich 1979). The majority of individuals interred on the right side had arms extended, with the feet oriented to the north, the head to the south, and the face turned to

face east, oriented toward Mecca (Souich 1979). None of the individuals were buried with grave goods, again typical of the Islamic and Christian stark burial styles (Souich 1979).

North Africa

As reviewed in earlier chapters, the Islamic conquest of southern Iberia followed the conquest of North Africa by Muslim Arabs. Many of the soldiers and migrants who moved into the peninsula with and following conquest were converted North African Berbers and Arabs. While medieval North African samples are currently unavailable for analysis, post-conquest North African Arabs (including some of Jewish origin) and Berbers, are examined in this study. Further, published cranial nonmetric data for pre-conquest Libyans are used as a comparative point. Here, I will discuss the context for these sites and the available individuals from each collection. These samples and their chronological and geographic contexts are depicted in Figure 6.3.

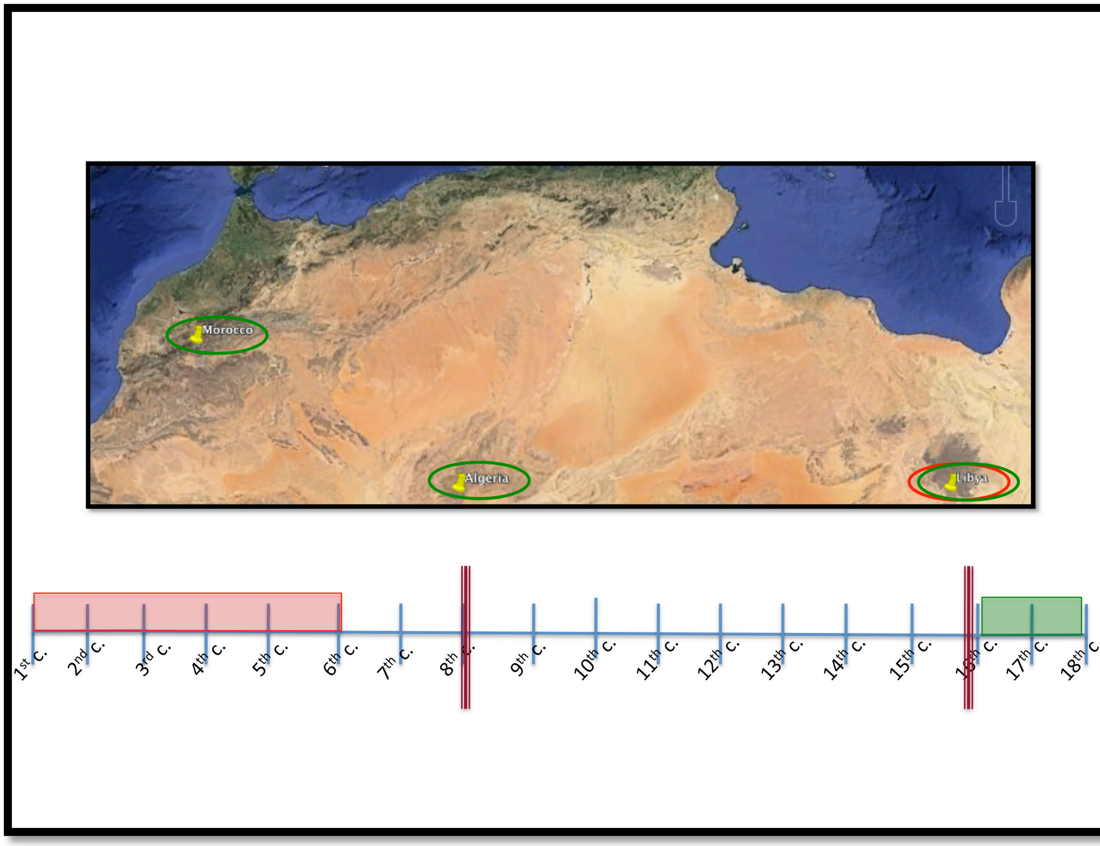

Figure 6.3 Chronological distribution and geographic area of African samples included in this study (Google Maps, 2017).

Garamantes

Perhaps one of the best-known and largest Berber kingdoms in the early centuries of the first millennium A.D. is that of the Garamantes of southwestern Libya (Dart, 1952; Mattingly, 2003). Known from Greek and Roman sources and extensive archaeological excavations at their capital city and surrounding settlements, the Garamantes established a large kingdom that reached its peak between 400 and 600 A.D. (Mattingly and Sterry 2013). The ongoing Desert Migrations Project to date has excavated 360 individuals from Garamante sites in Libya, dating to the 1st-8th c. AD. (Mattingly 2013). The preservation of these individuals is reported as suitable for biological distance analysis (Nikita et al.

2012), though inquiries as to the location of the collection and its availability for study were unanswered. Therefore published cranial nonmetric data for 46 individuals dated to the 1st-6th c. AD will be employed in this study to provide a comparative North African sample pre-dating the Islamic conquest in that region.

Berbers

The post-conquest North African Berber samples, currently curated in the Musée de l'Homme, Paris, comprise a total of 98 individuals available for analysis. This sample includes Shawia, Chaoui, and Kabyle Berbers from historic samples, collected between 1843 and 1887. The Shawia individuals are from an area to the south of Constantine, Algeria, near the towns of Setif, Tebessa, and Biskra, while the Chaoui individuals are named for the Chaouia region of Morocco (*Personal communication,* Dr. Joel Irish). The Kabyle Berbers are from northwest Africa, near Algiers (and Oran) in the Djurdjura Mountains of northern Algeria (Wysner 1945).

Bedouin Arabs and Jews

The Bedouin Arab and Jewish samples used in this study consist of 21 crania collected between 1829 and 1930. Thirty-six individuals were recovered from the coast of Morocco between Rabat and Mogador in northwest Africa and are currently curated at the Musée de l'Homme, Paris. Ten are from Algeria between Oran and Algiers, two are from Tunis, Tunisia, and one is from the Sahel region of Libya.

Summary

The research scenarios and questions in this dissertation address changes in social identity spurred by culture contact, migration, conversion, and, possibly, genetic exchange. In order to explore the degree to which the spread of Islamic influence may be attributed to either migration or conversion, I have selected samples from a particular region of southern Iberia, Andalucía, in order to examine changes in biological diversity through this time period. Further, I have identified samples from North Africa that provide an outgroup for comparison of changes in phenotypic variance and a possible source of variability in Iberian Islamic samples. This chapter provides an overview of the samples selected for analysis, outlining the excavation, preservation, demographic, and temporal characteristics of each sample. In the following chapter I present the data collection and preparation methods employed in analysis of these samples, as well as provide the justification and background information for the statistical procedures utilized in this study.

CHAPTER 7

METHODS

This chapter details the methods used in the organization, collection, and preparation of data used in this study. The analyses run in the course of data preparation, such those used to dichotomize the nonmetric data, or to test for normality among the metric samples, are described and results given here. Additionally, this chapter reviews the formulae and requirements for each of the statistical analyses used to examine this data. Those results are described in detail in the following chapter (Chapter 8).

Data Organization

As reviewed in the previous chapter, the skeletal preservation for the Islamic period collections included in this study is excellent, and while the preservation of pre-Islamic individuals is slightly less good, these collections have been chosen because of their utility for dental and cranial metric and nonmetric data collection. Each collection was recorded within a separate Microsoft Excel 2010 database, within which a master list of samples was created. For each individual, a two-page scoring sheet was utilized that recorded the sample number, site, storage locations, age, sex, cranial and dental metric and nonmetric data, and dental wear scores, as well as any notes on pathologies, traumas, etc. In this chapter, I will review the methods and techniques used to collect the metric and nonmetric data from the 873 individuals incorporated into this study, including the criteria used for inclusion, sex and age estimation, the measurement and recording of the data sets, and the initial steps for preparation of the data sets in anticipation of statistical analyses.

Criteria for inclusion

Each individual from whom data was collected for this study was examined for skeletal and taphonomic elements that potentially could affect the scoring and measuring necessary for this project. Crania that exhibited post-mortem fractures or reconstruction were not included in the cranial metric samples. Prior to collection of dental metric and nonmetric data, dental wear was evaluated following the criteria discussed by Jacobi (2000), and teeth with severe wear or with wear that obscured the nonmetric trait under consideration were excluded from study. Individual measurements noticeably affected by attrition or pathological conditions were noted but not recorded. Overall, the dentition of the Islamic period Iberian samples exhibited little wear or other forms of dental pathology.

Age and Sex Estimation

In order to address the research scenarios outlined for this study, the age and sex of individuals were estimated based on cranial and pelvic morphology, dental development, and tooth wear using standard osteological techniques (Buikstra and Ubelaker 1994; Hartnett 2010; Hillson 1996). As age was not a factor directly considered in the research questions outlined in this project, age assessments were recorded as broad categories of Juvenile (through roughly 21, based on eruption of third molars), Young Adult (21-35 years), Middle Adult (35-50 years), and Old Adult (50+ years). For Juveniles, more specific age ranges were noted based upon the degree of dental development and eruption.

For certain collections, sex assessments had not yet been completed or were not available during analysis. In those instances where sex assessment had been completed and my estimate did not correspond with the previous estimate, my estimate was utilized in order to maintain consistency. Sex estimates were scored for each individual as 'Female (F)', 'Male (M)', 'Probable Female (PF)', 'Probable Male (PM)', 'Undertermined (U)', and 'Juvenile (J)'. For the purpose of statistical analyses, those individuals labeled 'PF' were subsumed into the category 'F', and those individuals labeled 'PM' were subsumed into the category 'M'.

Because individuals were not otherwise separated by age for this analysis, and because the data collected from those individuals labeled as 'Juvenile (J)' were utilized only in the case of variables collected from permanent dentition for dental metric and nonmetric data and from crania from older juveniles (where third molars were erupting and cranial sutures had begun to close) for cranial metric and nonmetric data, this category and that of 'Undetermined (U)' were combined in statistical analyses. Table 7.1 indicates the number of males, females, and those labeled as indeterminate for each sample included in the analysis.

Table 7.1 Distribution of sex per sample included in this study.

Date	Group	Site/Region	Males	Females	Undetermined
1st c. B.C.	El Argar	Purullena	11	8	5
4th-8th c. A.D.	Hispano/Roman	Ecija Visigoth	6	2	5
4th-8th c. A.D.	Hispano/Roman	Cerro de San Cristobal	8	10	6
4th-8th c. A.D.	Hispano/Roman	Cortijo Coracho	26	19	18
5th-9th c. A.D.	Jewish	La Buhayra	N/A	N/A	46
8th-12th c A.D.	Jewish	Ronda Sur	49	26	26
8th-11th c. A.D.	Muslim	Ecija	166	114	20
10th-14th c. A.D.	Muslim	La Torrecilla	44	53	22
1st-8th c. A.D.	Garamante	Garama, Libya	20	26	0
17th-18th c. A.D.	Berber	Algeria, Morocco	49	44	5
17th-18th c. A.D.	Bedouin Arab/Jewish	Algeria, Tunisia, Libya	12	7	2

Data Collection

Dental Measurement

The mesiodistal and buccolingual diameters for the permanent maxillary and mandibular teeth were recorded at the cervico-enamel junction using Hillson-Fitzgerald Dental Calipers and according to standard techniques used in other dental metric studies (Hillson 1996; Hillson et al. 2005; Jacobi 2000; Stojanowski 2003; Stojanowski 2004). Measurements were recorded to 0.01mm. These measurements were input directly from the calipers to the Excel sheet using a data interface cord, reducing measurement fatigue and the risk of error in the transfer of data. Dental measurements were collected for the left side, but if left teeth were missing then the antimeres were substituted where possible.

Cranial Measurement

Sixteen standard cranial measurements were recorded for each individual included in the study. These measurements were selected based on the published success in recording and interpreting these data in studies of populations from similar geographic and temporal contexts (*e.g.* Zakrzewski 2011). Cranial measurements were recorded based on standards from Buikstra and Ubelaker (1994), with the right side substituted for the left wherever orbital breadth and height could not be measured for the left side. Measurements were recorded to 0.01mm using both digital spreading and digital sliding calipers. These measurements were input directly from the calipers to the Excel spreadsheet using a data interface cord, again reducing measurement fatigue and the risk of error in the transfer of data. The cranial landmarks from which the 16 measurements were taken are given in Table 7.2.

Table 7.2 Cranial metric measurements and landmarks.

Measurement	Landmarks
Maximum Cranial Length	g-op
Maximum Cranial Breadth	eu-eu
Bizygomatic Diameter	zy-zy
Basion-Bregma Height	ba-b
Basion-Prosthion Length	ba-pr
Maxillo-Alveolar Breadth	ecm-ecm
Maxillo-Alveolar Length	pr-alv
Upper Facial Height	n-pr
Minimum Frontal Breadth	ft-ft
Upper Facial Breadth	fmt-fmt
Nasal Height	n-ns
Nasal Breadth	al-al
Orbital Breadth	d-ec
Orbital Height	—
Biorbital Breadth	ec-ec
Interorbital Breadth	d-d

Dental Nonmetric Scoring

Thirty-six dental nonmetric traits were scored following the Arizona State Dental Anthropology System (ASUDAS) (Turner et al. 1991). The traits included in the ASUDAS were chosen based on their ease of observation, their persistence despite dental wear and taphonomic changes, and their lack of pronounced sexual dimorphism (Scott and Turner 1988). The traits scored in this study correspond with those employed in comparative studies of Iberia and North Africa (Irish 2000; Zakrzewski 2011). Using 27 rank-scale reference plaques and their corresponding descriptions to standardize dental

nonmetric scoring, bilateral traits were recorded in both antimeres and the side with highest expression counted (Turner et al. 1991, Scott and Turner 2000). This approach assumes scoring for the maximum genetic potential. Rank-scale traits were divided into categories of present/absent and dichotomization was based on each trait's morphological threshold according to standard procedures. The maxillary and mandibular trait lists and the corresponding teeth observed are provided in Tables 7.3 and 7.4.

Table 7.3 Dental nonmetric traits scored in the maxillary arcade.

Trait	Dentition Scored
Winging	I1
Labial Curve	I1
Shovel	I1, I2, C
Double Shovel	I1, I2, C, P1, P2
Interruption Groove	I1, I2
Tuberculum Dentale	I1, I2, C
Canine Medial Ridge	C
Canine Distal Accessory Ridge	C
Uto-Aztecan Premolar	P1
Metacone	M1, M2, M3
Hypocone	M1, M2, M3
Cusp 5	M1, M2, M3
Carabelli's Cusp	M1, M2, M3
C2 Parastyle	M1, M2, M3
Enamel Extension	P1, P2, M1, M2, M3
Peg/Reduced	I2, M3
Odontome	P1, P2
Congentical Absence	I2, P2, M3
Second Molar Root #	M2
First Premolar Root #	P1
Palatine Torus	Maxillary Palate
Midline Diastema	Midline Alveolus

Table 7.4 Dental nonmetric traits scored in the mandibular arcade.

Trait	Dentition Scored
Shoveling	I1, I2
Canine Dist Accessory Ridge	C
Premolar Lingual Cusps	P1, P2
Tomes Root	P1
Anterior Fovea	M1
Groove Pattern	M1, M2, M3
Molar Cusps No.	M1, M2, M3
Deflecting Wrinkle	M1
Distal Trigonid Crest	M1, M2, M3
Protostylid	M1, M2, M3
Cusp 5	M1, M2, M3
Cusp 6	M1, M2, M3
Cusp 7	M1, M2, M3
Enamel Extension	M1, M2, M3
Odontome	P1, P2
Congenital Absence	I2, P2, M3
Canine Root #	C
First Molar Root #	M1
Second Molar Root #	M2
Torsomolar Angle	M1, M2, M3
Mandibular Torus	Lingual Surface
Rocker Jaw	Gonial Angle

Cranial Nonmetric Scoring

Twenty-nine cranial traits were scored for presence or absence following the individual count method, whereby a trait is scored as present whether or not it appears bilaterally (Sutter and Mertz 2004), as unilateral scoring of cranial nonmetric traits reveals a strong correlation between sides (McGrath et al. 1984). Thus, the side with the highest degree of expression of a given trait was used in recording presence (Hauser and De Stefano 1989; Scott and Turner 1997). Traits were chosen based on their ease of observation despite imperfect preservation and their use in studies of comparable collections, so that future comparisons may be made between these data and other

published data sets (Dodo 1974; Hanihara et al. 2003; Nikita 2010; Nikita et al. 2012; Prowse and Lovell 1996; Sutter and Mertz 2004). The list of cranial traits scored is given in Table 7.5.

Table 7.5 Cranial nonmetric traits scored in this study.

Trait	Description
Apertures of Acoustic Meatus	Hauser and De Stefano (1989)
Coronal Ossicles	Hanihara and Ishida (2001)
Divided Infraorbital Foramina	Hauser and De Stefano (1989)
Divided Mental Foramina	Hauser and De Stefano (1989)
Divided Occipital Condyles	Hauser and De Stefano (1989)
Divided Parietal Bone	Hauser and De Stefano (1989)
Divided Temporal Squama	Hauser and De Stefano (1989)
Epipteric Bone	Dodo (1974)
Ethmoidal Foramina	Hauser and De Stefano (1989)
Foramen of Vesalius	Dodo (1974)
Foramen Ovale Incomplete	Dodo (1974)
Hypoglossal Canal Bridging	Dodo (1974)
Inca Bone	Dodo (1974)
Lambdoid Ossicles	Dodo (1974)
Lesser Palatine Foramina	Hauser and De Stefano (1989)
Mandibular Torus	Dodo (1974)
Marginal Tubercle	Hauser and De Stefano (1989)
Maxillary Torus	Hauser and De Stefano (1989)
Metopic Fissure	Hauser and De Stefano (1989)
Metopic Suture	Hauser and De Stefano (1989)
Mylohyoid Bridging	Dodo (1974)
Occipitomastoid wormians	Dodo (1974)

Os Japonicum	Dodo (1974)
Parietal Foramina	Hauser and De Stefano (1989)
Parietal Notch Bone	Dodo (1974)
Sagittal Ossicles	Hanihara and Ishida (2001)
Squamous Ossicles	Hanihara and Ishida (2001)
Supranasal Suture	Hauser and De Stefano (1989)
Zygomaxillary Tubercle	Hauser and De Stefano (1989)

Data Preparation

To prepare the data for input into both the model-bound and model-free statistical analyses outlined in the next chapter, a series of steps were required. In this section, I briefly review the steps taken to control for and reduce intra-observer error, to dichotomize and account for inter-trait correlation among the nonmetric traits, and to test for normality. Additionally, in this section I describe the approach used to account for missing data in the samples. Finally, I review the steps taken to produce effective population and heritability estimates for the metric data.

Intra-Observer Error

To assess intra-observer error, I re-recorded a random subset of the metric and nonmetric traits from approximately 20% of the individuals in each sample, at least several weeks after collection of the original data following the procedures outlined by Kieser (1990) and Hillson (1996), and Hillson et al. (2005). To test for intra-observer error, paired *t* tests were performed. The results suggest minimal bias was introduced into

the sample as a result of analyst error (p=0.136, n=296, 95% CI: -0.05,0.007, Students paired t-test; *e.g.* Figure 7.1).

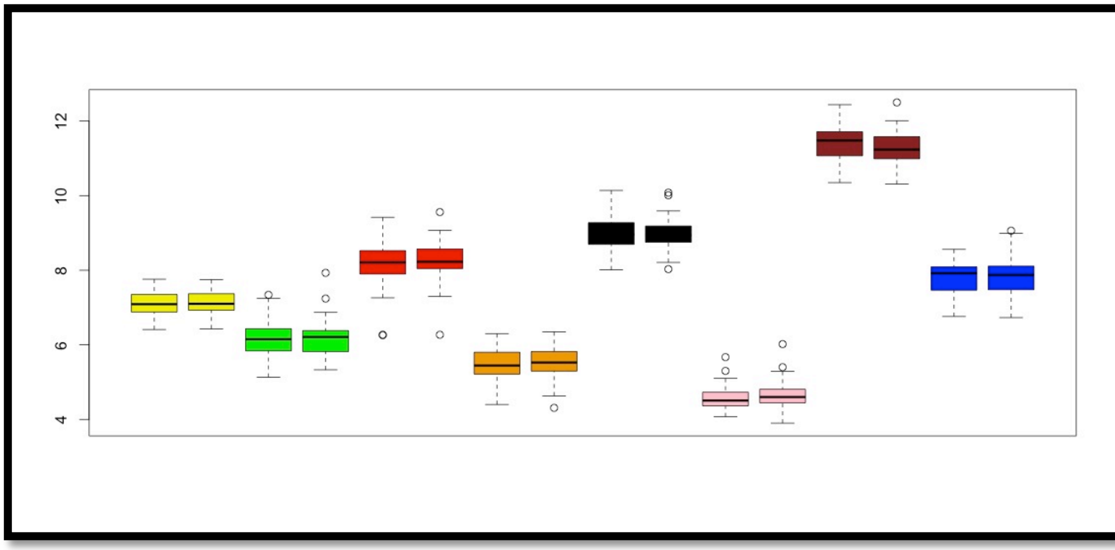

Figure 7.1 A boxplot representing a subset of the data (population Écija) used in the error analysis. Each subset of data (colors represent different variables) included in the error analysis suggests no significant difference in either the mean or distribution between the original data and the second observation recorded weeks later.

Data Cleaning, Inter-Trait and Sex Correlation, and Trait Dichotomization

In preparation for statistical tests, all data points were examined. Rare or difficult to score cranial and dental traits were excluded from the nonmetric analyses according to Sutter (1997), and Irish (1993), respectively, so that their frequencies would not affect the Mean Measure of Divergence (Sjøvold 1973). Individuals from whom a majority of measurements were unavailable were removed from analysis. To test for inter-trait correlation, Kendall's tau-b statistic was employed on the dental nonmetric variables. Those traits exhibiting significant correlations were not used in further statistical

analyses. For the cranial nonmetric data, sexual dimorphism in trait expression was explored with Chi-Square analysis. None of the 29 cranial traits were found to be significantly correlated with sex, thus all traits were included in further statistical analyses.

Because dental nonmetric traits may be expressed on several teeth in a given dental field, key teeth in each tooth class typically are those employed in biological distance statistical analyses (Pilloud 2009; Scott and Turner 1997; Stojanowski 2001). These key teeth are those that are most variable for a given trait and are typically the polar teeth in a given tooth class. The key teeth selected here were based upon the recommendation of Turner et al. (1991) and Scott and Turner (2000). They are listed in Table 7.6.

As mentioned previously, most traits observed in dental nonmetric trait analysis are scored for degree of expression. However, most statistical analyses require trait dichotomization into categories of presence or absence. While several researchers have developed and employed dichotomization schemes specific to their area of study (e.g. Nichol 1990; Scherer 2004), the majority of dental nonmetric studies use Turner's (1986, 1987) scheme to determine each trait's morphological threshold. To maintain the comparative ease of the data collected here, I assigned a breakpoint along the graded scale for each trait according to Turner (1986, 1987), demonstrated in Table 7.6.

Table 7.6 Dental nonmetric trait dichotomization scheme for key dentition.

Trait Observed	Key Dentition	Minimum Threshold
Labial Curve	UI1	2
Shovel	UI1	3
Double Shovel	UI1	2

Tuberculum Dent.	UC	2
Canine Mesial Ridge	UC	1
Canine Distal Accessory Ridge	UC	4
Metacone	M1	4
Metacone	M2	3
Metacone	M3	3
Hypocone	M1	4
Hypocone	M2	2
Hypocone	M3	2
M3 Cusp 5	M3	1
M2 Cusp 5	M2	1
M1 Cusp 5	M1	1
Carabelli's Cusp	U1M	2
Enamel Extension	U1M	1
Peg/Reduced	UM3	1
Peg/Reduced	UI2	1
Congenital Absence	UI2	1
Congenital Absence	UM3	1
UM2 Root #	UM2	3
UP1 Root #	UP1	2
Shoveling	LI1/2	1
Canine Distal Accessory Ridge	LC	1
Premolar Lingual Cusps	LP1	2 through 9
Anterior Fovea	LM1	3
Groove Pattern	LM1	+,X
Groove Pattern	LM2	X
Groove Pattern	LM3	X
Molar Cusps Number	LM1	6
Deflecting Wrinkle	LM1	2
Protostylid	LM2	1
Cusp 5	LM1	5
Cusp 6	LM1	1
Cusp 7	LM1	1
Enamel Extension	LM1	1
Congenital Absence	LI2	1
Congenital Absence	LM3	1
LC Root #	LC	2
LM1 Root #	LM1	3
LM2 Root #	LM2	3
Mandibular Torus	-	1
Palatine Torus	-	1
Midline Diastema	-	1
Rocker Jaw	-	1

Normality Tests

The multivariate statistics employed in this study generally require that the data are derived from a normally distributed population. All cranial and dental measurements were tested for normality in R version 3.2.2 using the Shapiro-Wilk test for normality (Shapiro and Wilk 1965). If the *p*-value is greater than the chosen alpha level, in this case 0.05, then the null hypothesis, that the population is normally distributed, cannot be rejected. If, for a given variable, the Shapiro-Wilk test produced a *p*-value less than 0.05, the Q-Q plot was examined for potential 'bad' data points (*i.e*. mis-entered, mis-recorded, etc.). These 'bad' data points were often due to shifted cells in the Excel spreadsheets used for digital recording, thus these points were re-examined in the original data sheets and updated wherever possible and the test re-run. Those variables that continued to produce *p*-values of less than 0.05 and abnormal Q-Q plots were eliminated from use in further analyses. Tables 7.7-9 show the results of these tests for the cranial and dental measurements and those variables that were eliminated from further analysis.

Table 7.7 Results of normality distribution tests for cranial measurements.

Measurement	**Shapiro-Wilk (*p value*)**	**QQ Plot**	**Eliminated**
Maximum Cranial Length	0.307	Normal	
Maximum Cranial Breadth	0.981	Normal	
Bizygomatic Diameter	0.423	Normal	
Basion-Bregma Height	0.425	Normal	
Basion-Prosthion Length	0.242	Normal	
Maxillo-Alveolar Breadth	0.222	Normal	
Maxillo-Alveolar Length	0.406	Normal	
Upper Facial Height	0.070	Normal	
Minimum Frontal Breadth	<0.001	Not Normal	**X**
Upper Facial Breadth	0.815	Normal	
Nasal Height	0.019	Normal	
Nasal Breadth	0.412	Normal	

Orbital Breadth	0.039	Normal	
Orbital Height	0.124	Normal	
Biorbital Breadth	0.134	Normal	
Interorbital Breadth	0.514	Normal	

Table 7.8 Results of normality distribution tests for maxillary dentition.

Measurement	Shapiro-Wilk (*p value*)	QQ Plot	Eliminated
BL I1	0.268	Normal	
BL C	0.006	Normal	
BL P1	0.694	Normal	
BL M1	0.717	Normal	
MD I1	<0.001	Not Normal	**X**
MD C	<0.001	Normal	
MD P1	<0.001	Not Normal	**X**
MD M1	<0.001	Normal	

Table 7.9 Results of normality distribution tests for mandibular dentition.

Measurement	Shapiro-Wilk (*p value*)	QQ Plot	Eliminated
BL I1	0.789	Normal	
BL C	0.126	Normal	
BL P1	0.044	Normal	
BL M1	0.430	Normal	
MD I1	0.054	Normal	
MD C	0.377	Normal	
MD P1	<0.001	Not Normal	**X**
MD M1	0.082	Normal	

Missing Data

Most bioarchaeological data sets face the problem of missing data, as ante-mortem and post-mortem tooth loss, preservation issues, and a host of other factors are expected components of research employing human skeletal remains. Because many multivariate statistical tests require complete datasets, researchers have utilized a number

of ways to estimate missing data. Mean substitution, regression analysis, multiple imputations, and maximum likelihood methods have all been used in biological studies to estimate missing data (Allison 2002; Kindschuh 2015; Passalacqua 2015; Pilloud 2009; Steadman 1997; Stojanowski 2001; Thompson 2013). Here, multiple imputation was employed using NORM software (NORM 1999; Schafer 1997; Schafer and Graham 2002) in order to complete the data sets.

Z-Score Transformation

To statistically mitigate potential age and sex biases in the analysis of the data, all measurements were converted into standardized *z* scores using Microsoft Excel, Version 12.3.5 (Steadman 1998). The *z* score is computed by subtracting the mean from the 'raw' data point and dividing by the standard deviation for the population. Because sex differences are of particular interest in this study, the data sets were separated into male and female prior to the *z*-score transformations and then re-combined into overall data sets per sample population (Kindschuh 2015; Madrigal 2012).

Population Estimates and Rankings

As discussed in Chapter 5, one of the fundamental parameters employed in model-bound biological distance methods, particularly the Relethford-Blangero model, is effective population size (Relethford 1996). Effective population size, calculated from demographic parameters of a given population in living groups, may be defined as the theoretical size of a population required for population genetics modeling. In analyses involving past populations, this parameter often is difficult to assess. In some cases,

reliable historical census data may be used to estimate effective population size (Stojanowski 2004), but in others the relative population sizes must be derived from archaeological estimates that are rough estimates at best (Passalaqua 2015; Powell and Neves 1999; Relethford and Harpending 1995; Scherer 2004; Steadman 1998, 2001). Because skeletal samples are multi-generational, often by several hundred years, the data do not represent true breeding populations. While the **R** matrix model may be run as an unscaled matrix, previous studies have found that the employment of this parameter in a scaled **R** matrix does affect results, as it adjusts for the potential of genetic drift in small populations (*e.g.* Scherer 2004). Due to this potential effect on the results of the biological distance analysis of the metric data, in this study I have chosen to run both unscaled and scaled **R** matrix analyses, in addition the using both model-free and model-bound approaches, to ensure this potential difference is captured and disclosed in the results.

As described in Chapters 2 and 4 of this study, there is an availability of historical data that can be employed in analyses of the social dynamics and timeline of events in medieval Iberia. However, as with much of the rest of medieval Europe, census data for medieval Iberia is fraught with error and hotly debated. Add to this issue the hazy scenario created by the movements of an unknown number of soldiers and immigrants in Iberia throughout the period of interest in this study, and population size estimates given for the regions in question are further obfuscated. However, several historians have used primary source documents, city maps, and other sources of archaeological information to estimate the populations of many larger cities in Iberia during the periods in question here (Cox Russell 1972; Fournel 1857; Gerli 2013; Torres Balbas 1972). Table 7.11 provides

an overview of census estimates for the cities and regions involved in this study. No population estimate could be found for Lucena. As Lucena in the Islamic period was roughly the same metric size as Écija, a population estimate was developed based on this relationship for the purpose of the scaled **R** matrix.

It is important to note that to employ a scaled **R** matrix, absolute population size estimates are not required. Rather, the relative population sizes for each site in comparison to one another are of greater importance for the model to run appropriately. This allows avoidance of methodological inconsistencies in the calculations of the original estimates and delivers a clearer picture of the relative sizes of these locations through time. The population size estimates recorded in Table 7.10 will be used for effective population estimates in the scaled **R** matrix analysis described in the next chapter.

Table 7.10 Population size estimates for the regions included in this analysis.

City/Region	Period	Population Estimate	Source
Écija	11th c. A.D.	18,000	Torres Balbas 1972
Granada	10th-12th c. A.D.	26,000	Gerli 2013
Lucena	11th c. A.D.	*15,000*	*NA*
Sevilla	10th-11th c. A.D.	45,000	Cox Russell 1972
Algeria (Berber)	17th c. A.D.	300,000	Fournel 1857

Heritability

In model-bound approaches to biological distance analysis, the heritability of phenotypic traits is another variable that must be factored into the analysis. The narrow-sense heritability of traits is the ratio of additive genetic variance to phenotypic variance

in a given population (Kieser 1990; Konigsberg 2000; Relethford 2007; Vitzthum 2003). Williams-Blangero and Blangero (1998) have demonstrated that it is possible to calculate minimum genetic distance with an assumed heritability of 1, but a more accurate value can be calculated by using specific or average heritability estimates for the traits under study. A number of individual, twin, and family heritability studies have been conducted to estimate heritabilities for dental and cranial variables (*e.g.* Alvesalo, 1971; Alvesalo and Tigerstedt 1974; Corruccini and Potter 1980; Dempsey et al. 1995; Devor 1987; Kieser 1990; Kolakowski and Bailit 1981; Potter and Nance 1976; Potter et al. 1968; Potter et al. 1976; Potter et al. 1983; Scott and Turner 1997; Townsend and Brown 1978a, b; Townsend et al. 1986). Among these, studies have indicated a heritability range of 0.40 to 0.80 for dental morphological traits (Scott and Turner 1997) and 0.60 to 0.80 for tooth size (Scott 1991), with an average of 0.62 for dental variables. Reported narrow-sense heritabilities of craniofacial traits are lower, and an average h^2=0.55 is most commonly used for cranial variables (Carson 2006; Cheverud et al. 1979; Cheverud 1988; Devor et al. 1985; Devor 1987; Konigsberg and Ousley 1995; Sjøvold 1984; Sparks and Jantz 2002; Susanne 1975, 1977). The use of this averaged heritability estimate for craniometric studies has been criticized as not accurately characterizing the range of heritabilites for different portions of the cranium (Carson 2006a), but RMET does not offer the option to input trait-specific heritabilities. As Relethford and Blangero (1990) found that the R matrix model produced in RMET is little affected by inputting differing heritability estimates, for the model-bound analyses performed here I employed a heritability estimate of 0.55. This estimate has been used successfully in similar recent

population genetic studies (e.g. Johnson 2016; Kindschuh 2015; Passalaqua 2015; Scherer 2004; Stojanowski 2004).

Statistical Analyses

To assess and compare changes in the phenotypic variability through time in southern Iberia, particularly in reference to the North African samples, a mix of model-free and model-bound statistical approaches was employed. These approaches provide measures of biological divergence and phenotypic variability, as well as inferences of population affinity among samples. In this section, I briefly review the details and justifications for the various model-free and model-bound approaches employed in this project.

To determine phenotypic variances using a model-free approach, a Levene's test, in which the response variable equals the difference between measurement observations and the sample median, was carried out (Levene 1960).

For a model-bound approach to the metric data, I construct scaled and unscaled **R** matrices using RMET to examine genetic distances among the southern Iberian samples (Relethford and Blangero 1990; Relethford et al. 1997; Relethford 2003). Further, the Relethford-Blangero model (Relethford and Blangero 1990) was utilized to examine the possibility of extra-local gene flow in these samples.

While extensions of the RMET package have been proposed for use with nonmetric data (*e.g.* Hanihara 2010), C.A.B. Smith's Mean Measure of Divergence (MMD) remains the most commonly employed statistical method in biological distance analysis for both cranial and dental nonmetric data, despite recent critiques (*e.g*. Harris et

al. 2008; Irish 2010; Konigsberg and Buikstra 2006). While acknowledging these critiques and their implications, I use the MMD statistic here in order to facilitate comparisons between the data employed in this study and the data published for other North African and Iberian samples (*e.g.* Bernis et al. 1986; Irish 2000; Jordana and Malgosa 2004; Lalueza Fox et al. 1996; McMillan and Boone 1999; Nikita et al. 2012; Zakrzewski 2011). Multi-dimensional scaling is used to illustrate the resulting distance values. Here, I describe the statistical methods employed in this study in more detail, focusing first upon the model-free approaches and second upon the model-bound approaches, concluding with a summary of the nonmetric data-specific analyses used.

Model-Free Approaches

Model-free approaches are widely used, rely on few theoretical assumptions, and can provide useful heuristic devices for determining general patterns of variability. Thus, in order to assess the phenotypic variance across sites (and therefore through time), I performed Levene's (1960) test on the metric data. This test assesses the null hypothesis that the population variances are equal across sites. In accordance with the typical use of the test in biodistance analyses, the null hypothesis will be rejected if the resulting *p*-value is less than 0.05. The equation for Levene's test is

$$W = \frac{(N-k)}{(k-1)} \frac{\sum_{i=1}^{k} N_i (Z_{i\cdot} - Z_{\cdot\cdot})^2}{\sum_{i=1}^{k} \sum_{j=1}^{N_i} (Z_{ij} - Z_{i\cdot})^2}$$

where N is the total sample size, k is the number of samples belong, N_i is the number of cases in the ith group, and $Z_{ij} = | Y_{ij} - \overline{Y}_{i,} |$ where Y_i is the mean of the ith sample.

the k traits. The Levene's Test was run in R 3.2.2.

Model-Bound Approaches

As described in previous sections, there are several interpretive advantages to model-bound approaches in biological distance analyses (Relethford and Blangero 1990). As the model-bound methods incorporate more assumptions and population genetic parameters, the results produced are argued to be more exact measurements of population similarity or dissimilarity. Derived from Harpending and Ward's (1982) **R** Matrix model, the model for quantitative traits developed by Relethford and Blangero (1990) is used here to measure phenotypic variance. The equation for the adapted model is

$$E[v_i] = \frac{\bar{v}_w (1 - r_{ii})}{1 - F_{ST}}$$

where the expected average phenotypic variance of all measured traits of population i is a function of the pooled average of within-group phenotypic variation for all measure traits of all the populations ($\bar{v}_w$), the genetic distance of the population to the centroid (r_{ii}), and the average genetic distance (F_{st}) (Relethford et al. 1997). The difference between the expected and observed heterozygosity produces a residual used to measure the relative extent of gene flow from extraregional sources in the population, with positive residuals indicating greater levels of gene flow from outside sources (Williams-Blangero and Blangero 1990). F_{st} represents the minimum genetic differentiation among regional populations, with low values indicating limited among-group genetic variation relative to total variation (Relethford 1994; Relethford and Blangero 1990; Relethford and

Harpending 1994; Williams-Blangero and Blangero 1989). Genetic distances can be derived from the **R** matrix as

$$d_{ij} = r_{ii} + r_{jj} - 2r_{ij}$$

where n_i is the sample size of group *i* (Harpending and Jenkins 1973; Relethford 1991). **R** matrices were constructed for all samples with the sexes pooled, then again with the sexes separated in order to examine sex-specific genetic distance and levels of phenotypic variability of each sex. Again, due to the difficulty posed in obtaining reasonable population estimates for medieval Iberia, both unscaled and scaled **R** matrices were constructed. All **R** matrix calculations were performed in RMET 5.0.

Nonmetric-Specific Analyses

As previously reviewed, model-bound statistical analyses are not commonly employed in studies of nonmetric data. While extensions of the RMET package have been proposed for use with nonmetric data (*e.g.* Hanihara 2010), C.A.B. Smith's Mean Measure of Divergence (MMD) remains the most commonly employed statistical method used in biological distance analysis for both cranial and dental nonmetric data, despite recent critiques (*e.g.* Konigsberg and Buikstra, 2006; Harris et al. 2008; Irish 2010). With these critiques and their implications acknowledged, the MMD statistic is used here in order to facilitate comparisons between the data employed in this study and the data published for other North African and Iberian samples.

First employed by Berry and Berry (1967), Green and Suchey (1976) modified the MMD statistic in order to stabilize the variance of unequal sample sizes. The formula for the MMD statistic most commonly used is

$$MMD = \sum_{i=1}^{r} \frac{(\theta_{1i} - \theta_{2i})^2 - (\frac{1}{n_{1i} + .5} + \frac{1}{n_{2i} + .5})}{r}$$

where i is a trait, r is the number of traits under consideration, θ_{1i} is the angular transformation of the frequency of the ith trait in the first sample, θ_{2i} is the angular transformation of the frequency of the ith trait in the second sample, n_{1i} is the number of individuals in the first sample observed for trait i, and n_{2i} is the number of individuals in the second sample observed for trait i. As an MMD is a measure of dissimilarity, lower values indicate greater affinity. To determine whether samples are significantly different from one another, the MMD is compared to its standard deviation and where MMD > 2xSD, the null hypothesis (P1=P2 where P=sample population) is rejected at a significance level of 0.025 (Sjøvold, 1977). All MMD analyses were run in R 3.2.2. Multi-dimensional scaling of the results of the MMD statistics were then used to further illustrate the distances visually.

Summary

This chapter reviews the methods with which the data utilized in this dissertation were organized, collected, and prepared for analysis. Further, this chapter describes the foundation of the statistical methods employed in this study, as well as the justification

for choosing these methods for analysis. The following chapter will discuss these methods in more detail as the results of these analyses are discussed.

CHAPTER 8

RESULTS—METRIC DATA

This chapter presents the results of the statistical analyses for the metric data described in detail in Chapter 7. Here, I review the results of the cranial and dental metric analyses separately, concluding with a summary interpretation of the data as a whole. In order to directly address the research questions and scenarios outlined in previous chapters, each section in this chapter moves from the examination of changes in phenotypic variability overall in the temporal transition in Andalucía from the pre-Islamic Period through the Late Islamic Period, to analyses more closely examining these outcomes. A synthesis and contextual interpretations of these data and the nonmetric results discussed in Chapter 9 are provided in Chapter 10.

Cranial Metric Analyses

Regional Phenotypic Variability Through Time

In order to address the dynamics of the 'Islamization' of the Iberian Peninsula, baseline analyses examining changes in phenotypic variance in Andalucía, Spain, from the Visogothic period through the end of the Islamic period, were performed using both model-free and model-bound approaches. For these analyses, Iberian samples were grouped according to the time period from which they date, with the early and late Islamic occupation phases delineated by the 12th century to better examine the possibility of an increase in Islamic converts in this later period. This section reviews the results of these analyses for the aggregate cranial metric data.

The results of the Levene's Test demonstrate that two of the sixteen craniometric variables showed significant differences in variation between time periods in Andalucía (p value <0.001, α=0.05). Specifically, the results demonstrate that these differences occur between the pre-Islamic and Early Islamic periods, where phenotypic variance increases significantly for the measurements G-OP and AL-AL (Table 8.1). From the Early Islamic to the Late Islamic periods, there is a decrease in phenotypic variance in these measurements.

Table 8.1 Results of the Levene's Test of craniometric variables. Bold values represent statistically significant differences in variance between Pre-Islamic, Early-Islamic, and Late Islamic groups.

Variable	Levene's *p* values
g.op	**0.0043**
eu.eu	0.2853
zy.zy	0.5918
ba.b	0.2806
ba.pr	0.6463
ec1.ec1	0.7835
pr.alv	0.9393
n.pr	0.4950
ft.ft	0.6986
fmt.fmt	0.9932
n.ns	0.0846
al.al	**0.0380**
d.ec	0.0988
oh	0.2691
ec.ec	0.7978
zy.zy	0.6918

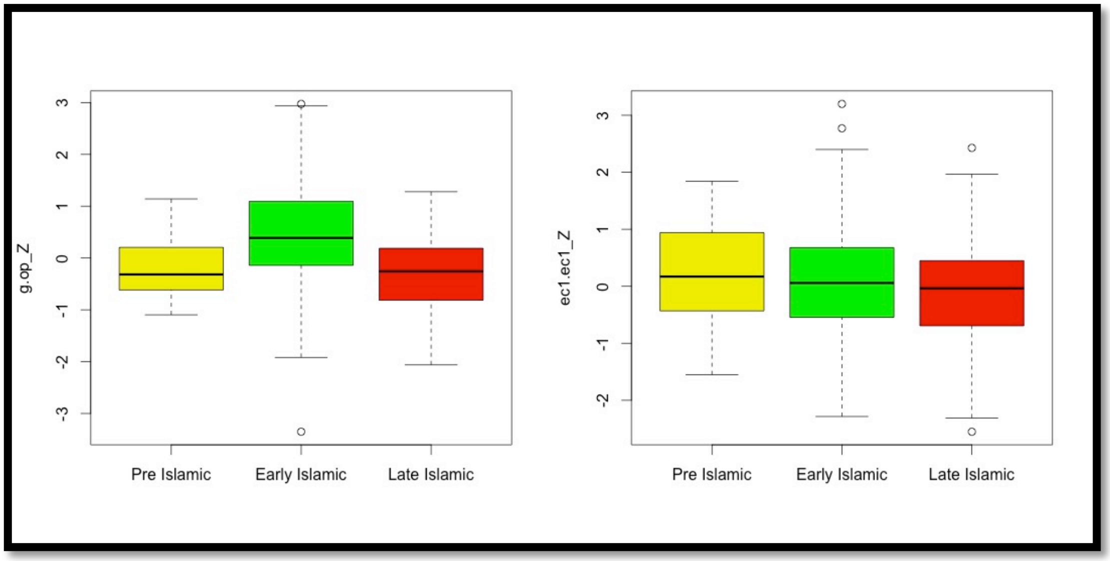

Figure 8.1 Excerpts of the results of Levene's Test depicting change in phenotypic variance in Andalucía through time. The left boxplot represents significant change in variation over time in the variable G-OP (*p*=<0.001) over time and, in contrast, the boxplot on the right illustrates very little change in variation observed in EC-EC over time (*p*= 0.78).

To further explore these results, the craniometric samples aggregated by time period were subjected to R-matrix analysis in RMET 5.0 using a heritability estimate of 0.55. The effective population size estimates described in Chapter 7 were used in this analysis. Among the genetic parameters that can be estimated from the R-matrix is a measure of regional genetic diversity, F_{ST}. Table 8.2 shows a summary of the F_{ST} results for Andalucía for the time periods of interest. When compared, the unbiased F_{ST} measures generated by each R-Matrix analysis indicate that there was less phenotypic variability among samples during the Pre-Islamic period (F_{ST}= 0.0046, se = 0.0096, p=0.33, α=0.05) than the Early Islamic period (F_{ST} = 0.0357, se = 0.0048, p=0.009, α=0.05), which is the only period for which the unbiased F_{ST} differs significantly from zero. This measure of increased phenotypic variability observed in Andalucía during the few centuries

following conquest remained fairly constant, though with a slight decrease, into the Late Islamic period (F_{ST} = 0.0332, se = 0.0073, p=0.068, α=0.05).

Table 8.2 Summary of the F_{ST} values for craniometric samples from Andalucía through time.

Period	# of Sites	F_{ST}	Standard Error	p value[1]
Pre-Islamic	4	0.0046	0.0096	0.33
Early Islamic	3	0.0357	0.0048	**0.009**
Late Islamic	2	0.0332	0.0073	0.068

[1]Bold values significant at alpha of 0.05

Biological Distances Between Samples

In order to explore these changes in phenotypic variation through time in Andalucía in more detail, I performed both unscaled and scaled **R** matrix and Relethford Blangero analyses for all of the sample populations included in the study. In the Relethford-Blangero analysis, negative residuals indicate below average extra-local gene flow, whereas positive values indicate greater than average extra-local gene flow. Jackknife resampling methods were employed to test whether distributions of residual values were significantly different from zero. The results of the Relethford-Blangero analysis for the unscaled craniometric samples are shown in Table 8.3.

Overall, the residuals for the Pre-Islamic samples analyses indicate below average extra-local gene flow in Andalucía during the Pre-Islamic period, much greater than average extra-local gene flow in Andalucía during the Early Islamic period, and below average extra-local gene flow in the Late Islamic period. Of particular relevance to the

research scenarios for this study, the residuals indicate statistically significant greater than average extra-local gene flow in the Islamic cemetery in Écija, dating to the Early Islamic period, with below average extra-local gene flow in the Late Islamic period Islamic cemetery of La Torrecilla, Granada. Also of interest and statistically significant is the below average extra-local gene flow in the Pre-Islamic site of Purullena in Granada.

Table 8.3 Results of Relethford-Blangero analysis for the total unscaled craniometric sample.

Population[1]	r(ii)	Observed Variance	Expected Variance	Residual[2]	p value
ÉcijaI	0.086711	1.018	0.93	**0.088**	0.0004
LucenaRS	0.038773	1.058	0.978	**0.08**	0.0002
LucenaC	0.002729	0.929	1.015	-0.086	0.0080
GranadaCSC	0.117972	1.153	0.898	0.255	0.0310
GranadaP	0.029648	0.667	0.988	**-0.32**	<0.0001
GranadaLaT	0.010135	0.85	1.008	**-0.158**	0.0001
SevilleT	0.018196	1.083	0.999	**0.083**	0.0001
NorthAfrica_B	0.07488	0.954	0.942	**0.012**	0.0001
NorthAfrica_AJ	0.087592	0.974	0.929	0.045	0.0012

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.4 presents the biological distances obtained from the unscaled **R** matrix of the craniometric samples. Overall, the Early Islamic cemetery in Écija, the Pre-Islamic cemetery of Cerro de San Cristobal, and the North African groups demonstrate the

greatest biological distance from the other sites in the sample. The remaining sites show relatively small distances to one another.

Table 8.4 Genetic distances derived from the unscaled **R** matrix of the craniometric sample.

	Ecija_I	LucenaRS	LucenaC	GranadaCSC	GranadaP	GranadaLaT	SevilleT	North Africa_B
LucenaRS	0.0777							
LucenaC	0.0777	0.0517						
GranadaCSC	0.2524	0.1608	0.1792					
GranadaP	0.1125	0.1030	0.0035	0.2704				
GranadaLaT	0.1289	0.0535	0.0204	0.1571	0.0225			
SevilleT	0.0443	0.0050	0.0798	0.1729	0.0808	0.0581		
NorthAfrica_B	0.2690	0.1550	0.1116	0.2284	0.1186	0.0483	0.1433	
NorthAfrica_AJ	0.2903	0.2488	0.0785	0.2502	0.0938	0.0797	0.1891	0.0772

A plot of the first two eigenvectors of the unscaled **R** matrix is presented in Figure 8.2. The first eigenvalue accounts for 44.6 % of the variation and the second eigenvalue accounts for 31.5 % of the variation. The first two eigenvalues collectively account for 76.1 % of the variation. The plot shows the North African samples, depicted in yellow, plotting closely together, the Hispano-Roman (Pre-Islamic) sites of Coracho, Lucena, and Purullena, Granada, depicted in red, plotting together, with the Hispano-Roman site Cerro de San Cristobal, Granada, also in red, an outlier. The Late Islamic site, La Torrecilla, plots closely with these Pre-Islamic samples. The Early Islamic samples from Écija, Sevilla, and Lucena plot fairly close together, though the Jewish cemeteries in Lucena and Sevilla are considerably closer to one another than either is to the Islamic group in Écija.

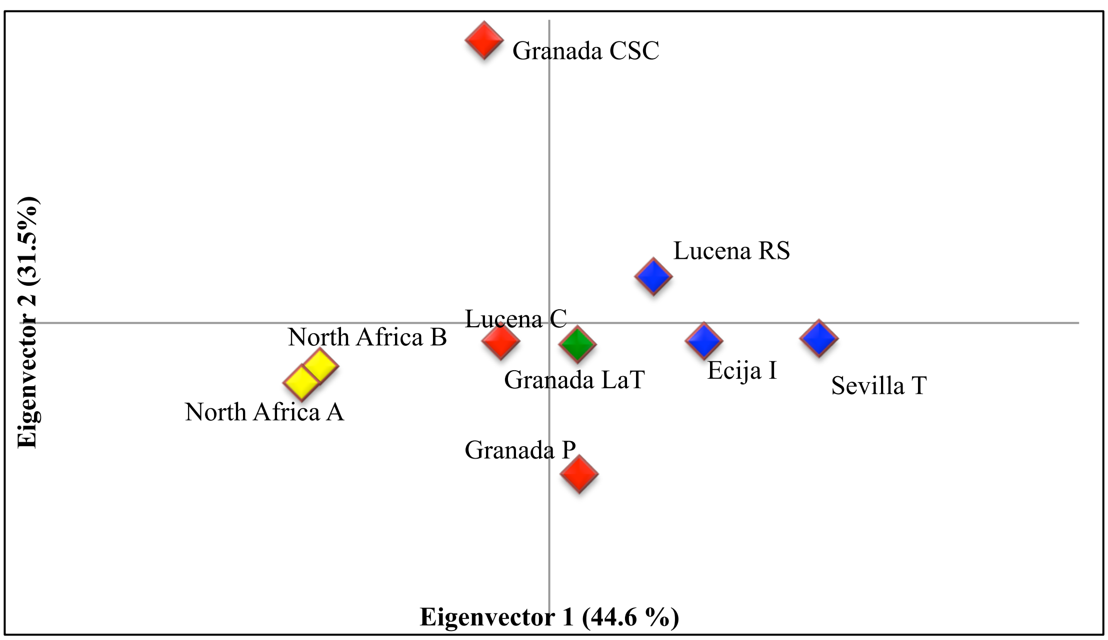

Figure 8.2 Plot of first two eigenvectors for all samples based on unscaled **R** matrix of craniometric data. (Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*)

When I re-ran the craniometric analysis using an **R** matrix scaled for population size, the overall patterns were similar to those obtained using an unscaled matrix. The results of the Relethford-Blangero analysis for the scaled craniometric samples are shown in Table 8.5. Jackknife resampling methods were employed to test whether distributions of residual values were significantly different from zero. Again, the residuals for this analysis indicate greater than average extra-local gene flow in the Islamic cemetery of Écija, dating to the Early Islamic period, and below average extra-local gene flow in the Late Islamic period Islamic cemetery of La Torrecilla. This analysis also demonstrated statistically significant below average extra-local gene flow in the North African Berber and Arab samples, as well as in the Pre-Islamic sample of Purullena, from Granada.

Table 8.5 Results of Relethford-Blangero analysis for the total scaled craniometric sample.

Population[1]	r(ii)	Observed Variance	Expected Variance	Residual[2]	p value
ÉcijaI	0.193015	1.018	0.811	**0.207**	<0.0001
LucenaRS	0.111675	1.058	0.893	**0.165**	<0.0001
LucenaC	0.086902	0.929	0.918	0.011	0.0220
GranadaCSC	0.201458	1.153	0.803	0.35	0.0019
GranadaP	0.094795	0.667	0.91	**-0.243**	<0.0001
GranadaLaT	0.03338	0.85	0.972	**-0.122**	<0.0001
SevilleT	0.120376	1.083	0.884	**0.198**	<0.0001
NorthAfrica_B	0.024008	0.954	0.981	**-0.028**	<0.0001
NorthAfrica_AJ	0.009242	0.974	0.996	**-0.022**	0.0070

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.6 presents the biological distances obtained from the scaled **R** matrix of the craniometric samples. As with the biological distances obtained from the unscaled **R** matrix, the Early Islamic cemetery in Écija, the Pre-Islamic cemetery of Cerro de San Cristobal, and the North African groups demonstrate the greatest biological distance from the other sites in the sample. The remaining sites show relatively small distances.

Table 8.6 Genetic distances derived from the scaled **R** matrix of the craniometric sample.

	Ecija_I	LucenaRS	Lucena C	Granada CSC	GranadaP	GranadaLaT	SevilleT	NorthAfrica_B
LucenaRS	0.1023							
LucenaC	0.0894	0.0664						
GranadaCSC	0.2735	0.1676	0.1883					
GranadaP	0.1296	0.1257	0.0364	0.342253				
GranadaLaT	0.1277	0.0348	0.0459	0.171603	0.0498			
SevilleT	0.0833	0.0606	0.1672	0.2593	0.1316	0.09545		
NorthAfrica_B	0.2627	0.1356	0.1457	0.257452	0.1505	0.05368	0.18527	
NorthAfrica_AJ	0.2657	0.2067	0.12625	0.254549	0.1301	0.088479	0.187688	0.076405

A plot of the first two eigenvectors of the scaled **R** matrix is presented in Figure 8.3, and demonstrates visually the difference between the results when the effective population size is incorporated into the model. The first eigenvalue accounts for 34 % of the variation and the second eigenvalue accounts for 32.4 % of the variation. The first two eigenvalues collectively account for 66.4 % of the variation. In this figure, it becomes apparent that the Late Islamic period group from La Torrecilla has plotted closer to the North African samples. Again, the necropolis of Serro de San Cristobal, Granada, presents as an outlier.

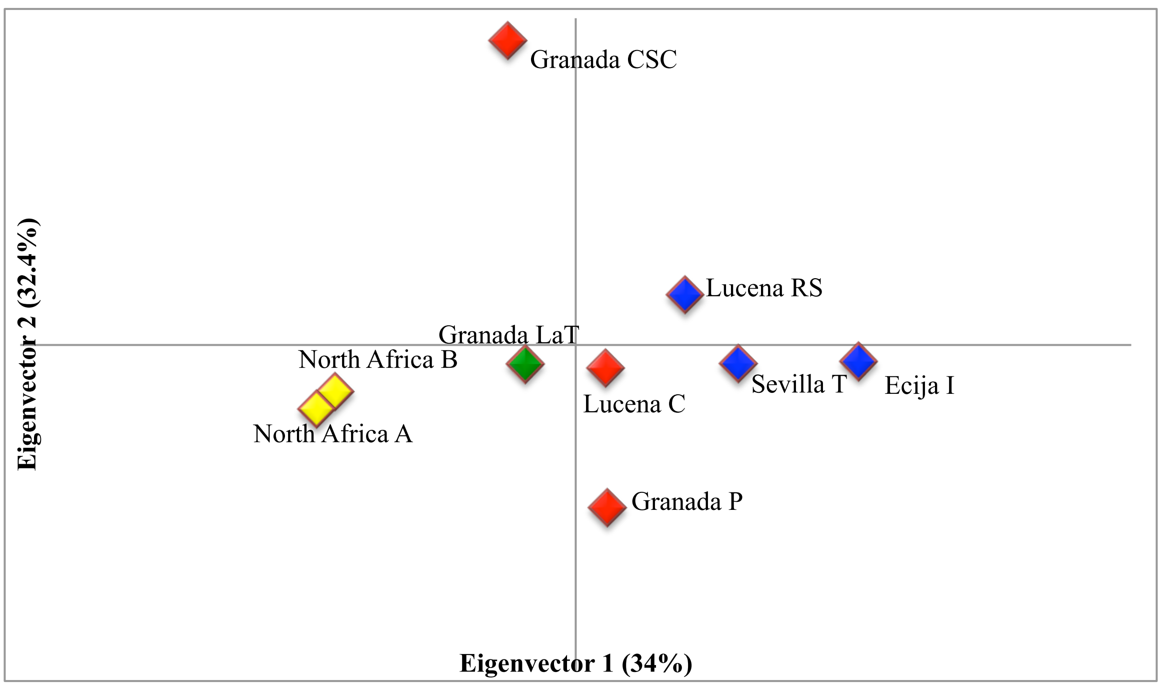

Figure 8.3 Plot of first two eigenvectors for all samples based on scaled **R** matrix of craniometric data. (Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*)

Identifying Possible Sources of Variability

Given the apparent increase in genetic variability between the Pre-Islamic and Early Islamic period samples, further analyses were run to determine whether this increase could be attributed to migration or conversion, as well as whether this increase could be differentiated between the sexes through time.

I performed **R** matrix analyses for the male and female aggregated craniometric samples for each time period of interest using a heritability estimate of 0.55. Table 8.7 shows a summary of the F_{ST} results for the samples in each period. When compared, the unbiased F_{ST} measures generated by each R-Matrix analysis indicate that there was less phenotypic variability among both male and female samples during the Pre-Islamic period (Males: F_{ST}= 0.0693, se = 0.025439, p=0.036, α=0.05; Females: F_{ST}= 0.0215, se = 0.035928, p=0.0004, α=0.05). During the Early Islamic period, the F_{ST} for males roughly doubles to 0.1105, demonstrating a great increase in genetic heterogeneity among males in this period. The F_{ST} for females in this period shows a stark contrast between the sexes and remains small, though it does not differ statistically from 0. In the Late Islamic period, the F_{ST} for males (0.05044, se = 0.013159, p=0.0157, α=0.05) decreases significantly, dropping slightly below the Pre-Islamic period measure. Though still lower than that of the males, the F_{ST} for females in this period (0.034924, se = 0.034924, p=0.02139, α=0.05) is the highest recorded for any period.

Table 8.7 Summary of the F_{ST} values for the aggregated sexes through time.

Period	Male F_{ST}[1]	Male SE	p value	Female F_{ST}[1]	Female SE	p value
Pre-Islamic	**0.0693**	0.02543	0.036	**0.0215**	0.035928	0.0004
Early Islamic	**0.1105**	0.01429	0.0296	0.0159	0.014662	0.1580
Late Islamic	**0.05044**	0.013159	0.0157	**0.034924**	0.010284	0.02139

[1]Values in bold are significant at alpha of 0.05.

To further explore these results, I examined the Relethford Blangero analyses with the sexes separate for all of the sample populations included in the study (Tables 8.8 and 8.9). Again, Jackknife resampling methods were employed to test whether distributions of residual values were significantly different from zero. Table 8.8 presents the male results for all samples included in the study. Of particular note, the residuals are positive for all sites in the Early Islamic period, demonstrating higher than expected within-group heterogeneity. The residuals demonstrating statistical significance for the Pre-Islamic period are represented by the males from Coracho, Lucena, and Purullena, Granada, and demonstrate less than expected gene flow. Males from the Late Islamic period site of La Torrecilla also demonstrate a negative residual with statistical significance.

Table 8.8 Results of Relethford-Blangero analysis for the male craniometric samples.

Population[1]	**r(ii)**	**Observed Variance**	**Expected Variance**	**Residual**[2]	**p value**
ÉcijaI	0.313985	0.966	0.683	**0.283**	<0.0001
LucenaRS	0.199255	1.183	0.797	**0.387**	<0.0001
LucenaC	0.044483	0.846	0.951	**-0.104**	0.0123
GranadaCSC	0.052445	0.926	0.943	-0.017	0.4775
GranadaP	0.225987	0.654	0.77	**-0.116**	0.0024
GranadaLaT	0.069555	0.882	0.926	**-0.044**	<0.0001
SevilleT	0.097938	1.132	0.898	**0.234**	<0.0001
NorthAfrica_B	0.023954	1.003	0.971	**0.031**	<0.0001
NorthAfrica_AJ	0.002113	0.91	0.993	**-0.083**	<0.0001

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.9 presents the female results for all samples included in the study. Here, as with the males, females from the Pre-Islamic sites of Purullena, Granada, and Coracho, Lucena, demonstrate negative residuals. The females from the Early Islamic period samples exhibit mixed residuals, with the Islamic style burials in Écija and the Jewish burials in Seville demonstrating higher than expected gene flow, and Jewish style burials in Lucena exhibiting lower than expected gene flow. The Late Islamic period site of La Torrecilla, as with the males, demonstrates negative residuals.

Table 8.9 Results of Relethford-Blangero analysis for the female craniometric samples.

Population[1]	r(ii)	Observed Variance	Expected Variance	Residual[2]	p value
ÉcijaI	0.199619	1.072	0.887	**0.185**	<0.0001
LucenaRS	0.174046	0.796	0.915	**-0.119**	0.0440
LucenaC	1.430174	1.007	-0.477	**1.484**	0.0037
GranadaCSC	0.255511	1.355	0.825	**0.53**	<0.0001
GranadaP	0.197599	0.682	0.889	**-0.207**	<0.0001
GranadaLaT	0.067745	0.84	1.033	**-0.193**	<0.0001
SevilleT	0.282584	1.128	0.795	**0.333**	0.0002
NorthAfrica_B	0.046403	0.904	1.057	**-0.153**	<0.0001
NorthAfrica_AJ	0.028573	1.089	1.077	0.013	0.4062

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.10 presents the biological distances obtained from the scaled **R** matrix of the male craniometric samples. Overall, males in the Early Islamic period sample from Écija and those from North Africa demonstrate the greatest biological distance from the other sites in the sample. The remaining sites show relatively comparable distances from each other. Of particular note, the males in the Pre-Islamic samples show very small distances to one another.

Table 8.10 Genetic distances derived from the scaled **R** matrix of the male craniometric samples.

	Ecija_I	**LucenaRS**	**Lucena C**	**Granada CSC**	**GranadaP**	**GranadaLaT**	**SevilleT**	**NorthAfrica _B**
LucenaRS	0.2239							
LucenaC	0.1037	0.0427						
GranadaCSC	0.2365	0.0000	0.0610					
GranadaP	0.2293	0.2361	0.0915	0.364117				
GranadaLaT	0.1972	0.1284	0.0426	0.060931	0.1707			
SevilleT	0.1733	0.0096	0.0872	0.0000	0.4546	0.107459		
NorthAfrica_B	0.4059	0.2379	0.1016	0.101947	0.2360	0.086958	0.205059	
NorthAfrica_AJ	0.4017	0.3286	0.082551	0.13541	0.3097	0.138017	0.141738	0.075018

Table 8.11 presents the biological distances obtained from the scaled **R** matrix of the female craniometric samples. Overall, females in the Hispano-Roman site of Coracho, Lucena, and those from North Africa demonstrate the greatest biological distance from the other sites in the sample. The remaining sites show relatively comparable distances from each other. Of particular note, the females in the Late Islamic site La Torrecilla show the greatest similarity to those of the North African Berber sample. This trend could indicate that the establishment of the Berber Almohad regime in the 12^{th} century resulted in a further influx of peoples, rather than the forced conversion of Iberians that has been hypothesized for the Late Islamic period. These patterns will be explored in more detail in their interpretive contexts in the following chapters.

Table 8.11 Genetic distances derived from the scaled **R** matrix of the female craniometric samples.

	Ecija_I	**LucenaRS**	**Lucena C**	**GranadaCSC**	**GranadaP**	**GranadaLaT**	**SevilleT**	**N. Africa_B**
LucenaRS	0.1925							
LucenaC	1.3504	1.6052						
GranadaCSC	0.4865	0.3055	1.5330					
GranadaP	0.2854	0.3679	1.4564	0.569853				
GranadaLaT	0.1320	0.1340	1.3441	0.370909	0.1040			
SevilleT	0.1347	0.4276	1.4246	0.7356	0.2167	0.094869		
N. Africa_B	0.2665	0.1428	1.6541	0.359689	0.1972	0.05589	0.263652	
N. Africa_AJ	0.3256	0.3388	1.548976	0.254192	0.3813	0.2365	0.562264	0.198032

Dental Metric Analyses

Regional Phenotypic Variance Through Time

As with the craniometric data, I performed both model-free and model-bound analyses using the dental metric data collected from Andalucían samples to examine changes in phenotypic variance from the Visogothic period through the end of the Islamic period. The Iberian samples were again grouped according to the time period from which they date, with the early and late Islamic occupation phases delineated by the 12th century to better examine the possibility of an increase in Islamic converts in this later period. This section reviews the results of these analyses for the aggregate dental metric data.

Shown in Table 8.12, results of the Levene's Test demonstrate that two of the thirteen dental metric variables showed significant differences in variation between time periods in Andalucía (*p* value <0.001, alpha = 0.005). Specifically, the results demonstrate that these differences occur between the Pre-Islamic and Early Islamic periods, where phenotypic variation increases significantly for the measurements BL UI1 and BL LP1. From the Early Islamic to the Late Islamic periods, there is a decrease in phenotypic variance in these measurements. Figure 8.4 demonstrates excerpts of the Levene's Test.

Table 8.12 Results of the Levene's Test of dental metric variables.

Variable	Levene's *p* values
UI1BLC	**0.0270**
UCBLC	0.8817
UP1BLC	0.3244
UM1BLC	0.1593
UCMDC	0.4463
UM1MDC	0.0811
LI1BLC	0.6623
LCBLC	0.7427
LP1BLC	**0.0121**
LM1BLC	0.1477
LI1MDC	0.0996
LCMDC	0.2245
LM1MDC	0.2228

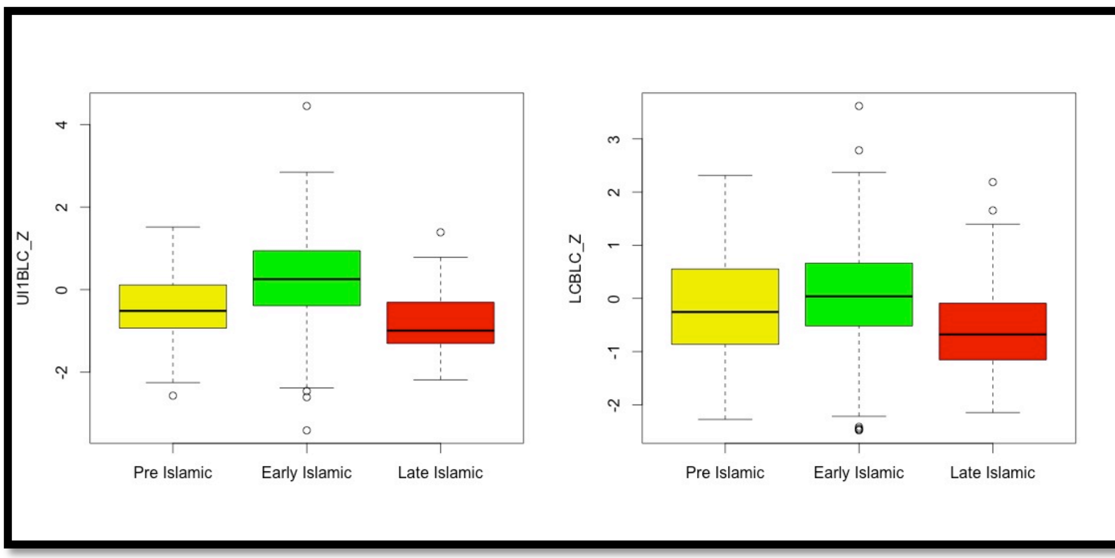

Figure 8.4 Excerpts of the results of Levene's Test depicting change in dental metric phenotypic variance in Andalucía through time. The boxplot on the left tracks the variance in the variable UI1 BL, illustrating a significant change in variance over time (p= <0.001). In contrast, the right boxplot of LC BL shows no significant change in variance through time (p= 0.74).

To further explore these results, the dental metric samples aggregated by time period were subjected to **R** matrix analysis in RMET 5.0 using a heritability estimate of 0.55. Effective population size estimates were used in this analysis. Table 8.13 shows a

summary of the F_{ST} results for Andalucía for the time periods of interest. When compared, the unbiased F_{ST} measures generated by each R-Matrix analysis indicate that the phenotypic variability among samples during the Early Islamic period (F_{ST}= 0.0782, se = 0.0166, p=0.0210, α=0.05) increases only slightly from that of the Pre-Islamic period (F_{ST} = 0.0755, se = 0.0162, p=0.0094, α=0.05). This measure of phenotypic variability observed in Andalucía decreases into the Late Islamic period (F_{ST} = 0.0048, se =0.0042, p=0.2288, α=0.05), though this unbiased estimate of F_{ST} does not differ significantly from 0. This overall trend is similar to that seen in the results of the craniometric data, though the changes are much less marked in the results of the dental metric data.

Table 8.13 Summary of the $\mathbf{F_{ST}}$ values for dental metric samples from Andalucía through time.

Period	# of Sites	F_{ST}	Standard Error	p value[1]
Pre-Islamic	4	0.0755	0.0162	**0.0094**
Early Islamic	3	0.0782	0.0166	**0.0162**
Late Islamic	3	0.0048	0.0091	0.2288

[1]Bold values significant at alpha of 0.05

Biological Distance Between Samples

To further explore these changes in phenotypic variation through time in Andalucía, I performed both unscaled and scaled **R** matrix and Relethford Blangero analyses for all of the sample populations included in the study. Jackknife resampling methods were employed to test whether distributions of residual values were significantly

different from zero. The results of the Relethford-Blangero analysis for the unscaled dental metric samples are shown in Table 8.14. In concordance with the craniometric results, and of particular relevance to the research scenarios and expectations for this study, the residuals for this analysis indicate greater than average extra-local gene flow in the Early Islamic period samples from the Islamic cemetery in Écija. Below average extra-local gene flow is seen represented by the residuals for the Pre-Islamic sites of Cerro de San Cristobal, and Purullena, Granada.

Table 8.14 Results of Relethford-Blangero analysis for the total unscaled dental metric sample.

Population[1]	r(ii)	Observed Variance	Expected Variance	Residual[2]	p value
ÉcijaI	0.141628	0.842	0.744	**0.097**	0.00002
Écija_V	0.238959	0.773	0.66	0.113	0.7350
GranadaCSC	0.010617	0.788	0.858	**-0.07**	0.00585
GranadaLaT	0.045131	0.809	0.828	-0.019	0.35890
GranadaP	0.035745	0.623	0.836	**-0.213**	0.01000
LucenaC	0.019952	0.898	0.85	**0.048**	0.00965
LucenaRS	0.054873	0.84	0.819	0.021	0.27340
SevillaDJ	0.022046	0.765	0.848	-0.083	0.07720
SevillaT	0.025342	0.615	0.845	**-0.23**	0.01321
NorthAfricaB	0.009937	0.934	0.858	0.075	0.12368
NorthAfrica_AJ	0.211653	0.944	0.684	**0.261**	0.00002

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.15 presents the biological distances obtained from the unscaled **R** matrix of the dental metric samples. Overall, the biological distances obtained for the unscaled **R** matrix for the craniometric data are similar to those obtained here. The Pre-Islamic Visigoth and the Early Islamic samples from Écija and the North African groups demonstrate the greatest biological distance from the other sites in the sample. Of note, the Pre-Islamic sample from Cerro de San Cristobal, Granada, now shows a relatively small distance to the other Iberian sites from this period. The remaining site comparisons show relatively small distances.

Table 8.15. Genetic distances derived from the unscaled **R** matrix of the dental metric sample.

	Ecija_I	Ecija_V	Granada CSC	Granada LaT	Granada P	Lucena C	Lucena RS	Sevilla DJ	Sevilla T	N.Africa B
Ecija_V	0.0906									
Granada CSC	0.2338	0.3913								
Granada LaT	0.3140	0.3850	0.0307							
Granada P	0.1963	0.3541	0.0472	0.055943						
Lucena C	0.1848	0.2793	0.0590	0.048586	0.0222					
Lucena RS	0.2770	0.3577	0.0404	0.0491	0.1039	0.07634				
SevillaDJ	0.2021	0.3008	0.0379	0.01114	0.0396	0.04225	0.043305			
SevillaT	0.2297	0.3476	0.001899	0.068492	0.1119	0.03263	0.087202	0.0812		
N.Africa B	0.2026	0.3737	0.0000	0.042286	0.0310	0.03408	0.071078	0.0299	0.0484	
N.Africa_AJ	0.4465	0.6895	0.1672	0.3190	0.2995	0.27744	0.3240	0.3060	0.2856	0.1293

Figure 8.5 shows a plot of the first two eigenvectors of the unscaled **R** matrix for the dental metric data. The first eigenvalue accounts for 52.5 % of the variation and the second eigenvalue accounts for 25.8 % of the variation. The first two eigenvalues collectively account for 78.3 % of the variation. Overall, the plot is similar to that of the craniometric data, with the North African samples plotting together, the Hispano-Roman (Pre-Islamic) sites of Coracho, Lucena, and Purullena, Granada plotting together (in red), and the Jewish samples from Sevilla and Lucena plotting closely together. A few differences do occur. Here, the Hispano-Roman site Cerro de San Cristobal, Granada, is no longer an outlier, but plots closely with the other Hispano-Roman sites. The Late Islamic site, La Torrecilla, plots closely with these Pre-Islamic samples as in the craniometric plot, but Ronda Sur, Lucena is now plotting with this group, rather than with the Early Islamic site of Écija. The samples from Écija plot fairly close together and at a distance from the other samples. Finally, the North African Berber samples plot fairly distant from the North African Arab samples. Perhaps the most perplexing result is the distance between the Pre-Islamic sample from the Visigothic period site at Écija and the other Pre-Islamic samples. Further analysis is required to tease apart these differences between sites.

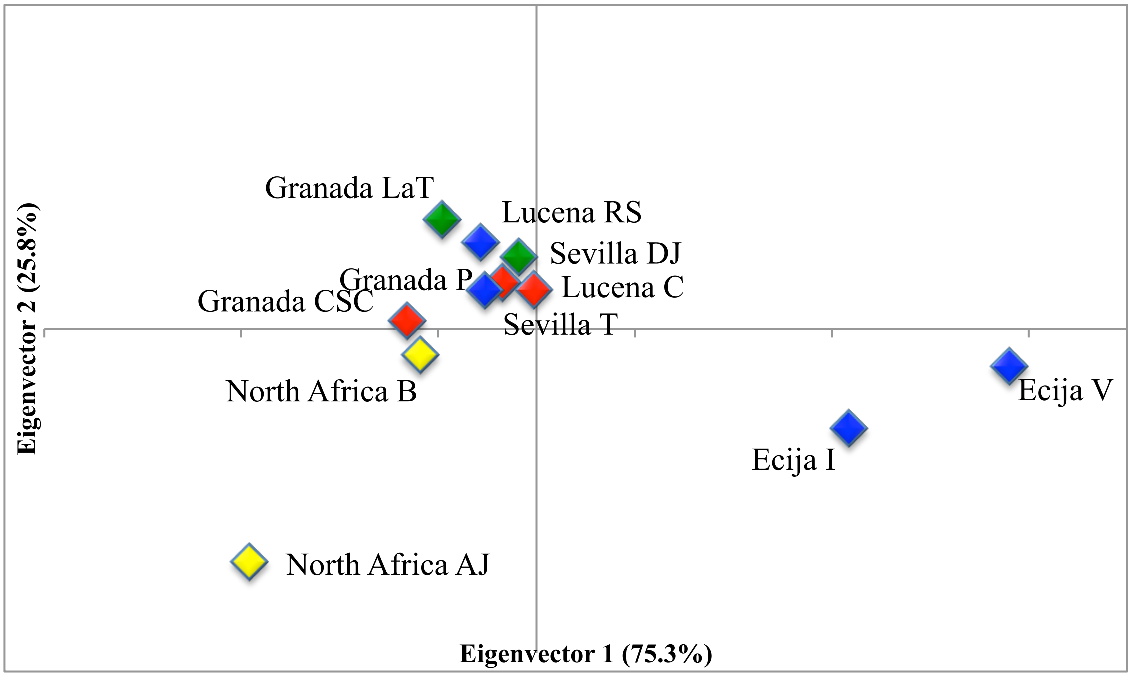

Figure 8.5 Plot of first two eigenvectors for all samples based on unscaled **R** matrix of dental metric data. (Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*)

As with the craniometric data, when I re-ran the dental metric analysis using an **R** matrix scaled for population size, the results were similar to those obtained using an unscaled matrix, though more results were statistically significant in the scaled analysis. The results of the Relethford-Blangero analysis for the scaled dental metric samples are shown in Table 8.16. Jackknife resampling methods were employed to test whether distributions of residual values were significantly different from zero. As with the unscaled results, the residuals for this analysis indicate greater than average extra-local gene flow in Early Islamic samples from Écija, and below average extra-local gene flow in all Pre-Islamic sites aside from Coracho, Lucena. Late Islamic period samples, such as

the Islamic sample from La Torrecilla, Granada reveal below average extra-local gene flow.

Table 8.16 Results of Relethford-Blangero analysis for the total scaled dental metric sample.

Population[1]	**r(ii)**	**Observed Variance**	**Expected Variance**	**Residual[2]**	**p value**
Écija_I	0.199991	0.842	0.719	**0.123**	<0.0001
Écija_V	0.37604	0.773	0.561	**0.212**	0.0003
GranadaCSC	0	0.788	0.899	**-0.111**	0.0002
GranadaLaT	0.055475	0.809	0.849	**-0.04**	0.0050
GranadaP	0.049629	0.623	0.854	**-0.231**	<0.0001
LucenaC	0.040595	0.898	0.862	**0.036**	0.0409
LucenaRS	0.071154	0.84	0.835	0.005	0.3410
SevillaDJ	0.036863	0.765	0.866	**-0.101**	0.0000
SevillaT	0.045041	0.615	0.858	**-0.243**	0.0070
NorthAfricaB	0	0.934	0.899	**0.035**	<0.0001
NorthAfrica_AJ	0.255011	0.944	0.669	**0.275**	0.0000

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.17 presents the biological distances obtained from the scaled **R** matrix of the dental metric samples. As with the biological distances obtained from the unscaled **R** matrix, the samples from Écija and the North African groups demonstrate the greatest biological distance from the other sites in the sample. The remaining sites show relatively small distances to one another.

Table 8.17 Genetic distances derived from the scaled **R** matrix of the dental metric sample.

	Ecija_I	**Ecija_V**	**Granada CSC**	**Granada LaT**	**Granada P**	**Lucena C**	**Lucena RS**	**Sevilla DJ**	**Sevilla T**	**N.AfricaB**
Ecija_V	0.0887									
Granada CSC	0.2571	0.4381								
GranadaLaT	0.3543	0.4710	0.0415							
GranadaP	0.2250	0.3762	0.0640	0.046255						
Lucena C	0.1882	0.3065	0.0766	0.061513	0.0260					
Lucena RS	0.3020	0.4415	0.0421	0.0586	0.0896	0.083706				
Sevilla DJ	0.2248	0.3755	0.0473	0.016796	0.0385	0.058591	0.058719			
Sevilla T	0.2426	0.3905	0.020551	0.093431	0.1470	0.045923	0.100898	0.1186		
N.AfricaB	0.2343	0.4459	0.0000	0.06509	0.0598	0.059513	0.087279	0.0487	0.0735	
N.Africa_AJ	0.5652	0.8658	0.2614	0.4761	0.4588	0.411435	0.4483	0.4442	0.4247	0.2136

A plot of the first two eigenvectors of the scaled **R** matrix is presented in Figure 8.6, and demonstrates visually the slight difference between the results when the effective population size is incorporated into the model. The first eigenvalue accounts for 50.1% of the variation and the second eigenvalue accounts for 30.2 % of the variation. The first two eigenvalues collectively account for 80.2 % of the variation.

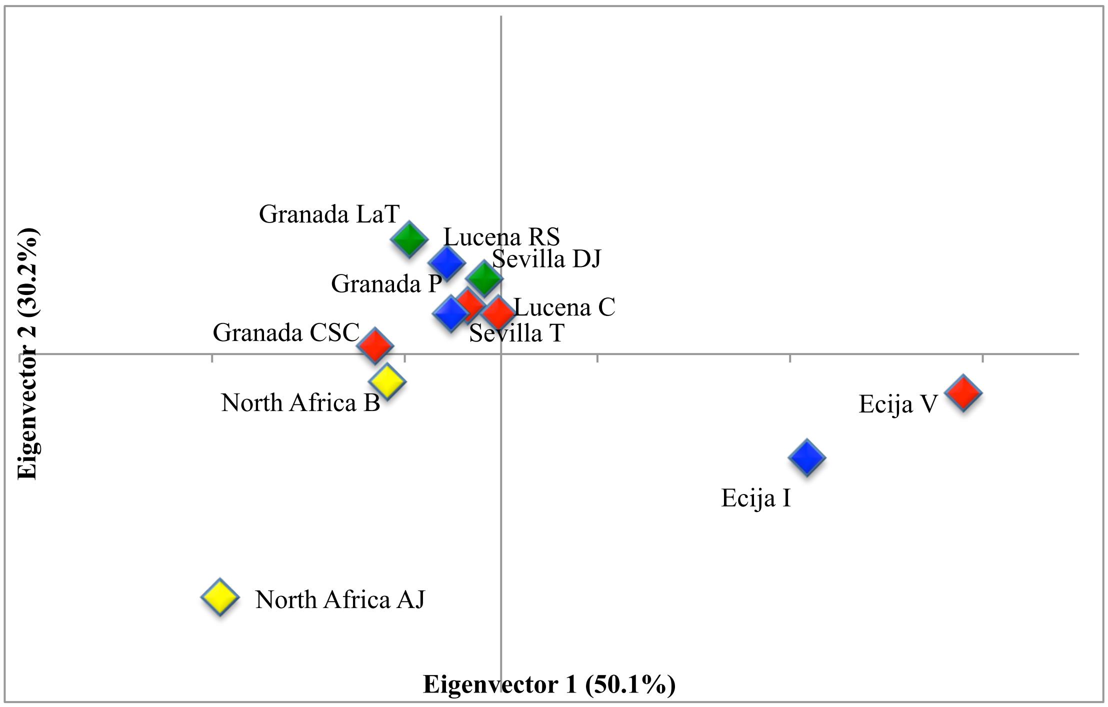

Figure 8.6 Plot of first two eigenvectors for all samples based on scaled **R** matrix of dental metric data. (Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*)

Identifying Possible Sources of Variability

I performed **R** matrix analyses for the male and female aggregated dental metric samples using a heritability estimate of 0.55. Table 8.18 shows a summary of the F_{ST} results for the time periods of interest. The results of this analysis reveal an interesting

trend in reference to the males and females of the Pre-Islamic period. When compared, the unbiased F_{ST} measures generated by each R-Matrix analysis indicate that there was far less phenotypic variability among males than females during the Pre-Islamic period (Males: F_{ST}= 0.0778, se = 0.0240, p=0.0238, α=0.05; Females: F_{ST}= 0.2410, se = 0.0267, p=0.0014, α=0.05). Further contextualized analysis is necessary at these sites in order to tease apart this pattern in its historical context. In contrast to the results of the craniometric analysis, the dental metric data suggest that the level of phenotypic remains roughly similar during the Early Islamic period. The F_{ST} for females in this period decreases greatly, and is comparable to that of the males in this period.

Table 8.18 Summary of the F_{ST} values for the sexes in aggregated sites through time, dental metric data.

Period	Male F_{ST}[1]	Male SE	p value	Female F_{ST}[1]	Female SE	p value
Pre-Islamic	**0.0778**	0.0240	0.0238	**0.2410**	0.0267	0.0014
Early Islamic	**0.0743**	0.0075	0.0320	**0.0711**	0.0177	0.0284
Late Islamic	0.0067	0.0076	0.2706	0.0100	0.0086	0.2261

[1]Values in bold are significant at alpha of 0.05

To further explore these patterns, I performed scaled **R** matrix and Relethford-Blangero analyses with the sexes separated for all of the sample populations included in the study (Tables 8.19 and 8.20). Effective population size estimates were used in these analyses and jackknife resampling methods were employed to test whether distributions

of residual values were significantly different from zero. Of note and statistically significant, overall males from the Pre-Islamic and Late Islamic samples show less than expected extra-local gene flow, while the males from the Early Islamic period site of Écija show much greater than expected extra-local gene flow.

Table 8.19 Results of Relethford-Blangero analysis for the scaled male dental metric samples.

Population[1]	r(ii)	Observed Variance	Expected Variance	Residual[2]	p value
ÉcijaI	0.413694	0.833	0.544	**0.288**	0.00003
Écija_V	0.461575	0.838	0.5	**0.338**	0.00109
GranadaCSC	0.33482	0.635	0.618	0.018	0.35046
GranadaLaT	0.040387	0.787	0.891	**-0.104**	0.00102
GranadaP	0.077069	0.594	0.857	**-0.263**	<0.0001
LucenaC	0.074249	0.875	0.86	0.015	0.22474
LucenaRS	0.07508	0.847	0.859	-0.012	0.31033
SevillaDJ	0.04807	0.758	0.884	**-0.126**	0.00005
NorthAfricaB	0.001211	0.835	0.928	**-0.093**	0.00002
NorthAfrica_AJ	0.410887	1.591	0.547	**1.044**	<0.0001

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

When these results are compared to those of the Relethford-Blangero analysis for female dental metric data, there is a similarity in the appearance of greater extra-local gene flow than expected for the samples from the Early Islamic site of Écija, but with the females this trend continues in the Late Islamic site of La Torrecilla, Granada, as well (Table

8.20). This measure is the first example of higher-than expected gene flow for a sample in the Late Islamic period, and will be re-examined in light of the contextual research scenarios in Chapter 10. The results demonstrate lower than expected extra-local gene flow for the Pre-Islamic samples.

Table 8.20 Results of Relethford-Blangero analysis for the female dental metric samples.

Population[1]	r(ii)	Observed Variance	Expected Variance	Residual[2]	p value
ÉcijaI	0.204852	0.855	0.708	**0.147**	0.00001
Écija_V	0.815401	0.728	0.164	**0.563**	0.00004
GranadaCSC	0.02814	0.748	0.866	**-0.118**	0.00104
GranadaLaT	0.132872	0.83	0.772	**0.058**	0.00331
GranadaP	0.149944	0.639	0.757	**-0.118**	0.00820
LucenaC	0.101096	0.949	0.801	**0.148**	0.00016
LucenaRS	0.102825	0.838	0.799	**0.039**	0.03083
SevillaDJ	0.087902	0.808	0.812	-0.005	0.45323
SevillaT	0.02989	0.53	0.864	**-0.334**	<0.0001
NorthAfricaB	0.002357	0.913	0.889	**0.024**	0.04912
NorthAfrica_AJ	0.236156	0.581	0.68	**-0.1**	0.00390

[1]Écija I: *Islamic period Écija*; Granada CSC: *Cerro de San Cristobal*; Granada P: *Purullena*; Granada LaT: *La Torrecilla*; Lucena C: *Coracho*; Lucena RS: *Ronda Sur*; North Africa A: *Arab*; North Africa B: *Berber*; Sevilla T: *Tentudia*. [2]Values in bold are significant at alpha of 0.05.

Table 8.21 presents the biological distances obtained from the scaled **R** matrix of the scaled male dental metric samples. Overall, males in the sample from Écija and those from North Africa demonstrate the greatest biological distance from each other and from

the other sites in the sample. The remaining sites show relatively comparable distances. Similar to the craniometric results, the males in the Pre-Islamic samples show very small distances to one another. The Jewish male samples in Sevilla and Lucena show the smallest distances to one another.

Table 8.21 Genetic distances derived from the scaled **R** matrix of the scaled male dental metric samples.

	EcijaI	**Ecija_V**	**Granada CSC**	**Granada LaT**	**Granada P**	**Lucena C**	**Lucena RS**	**Sevilla DJ**	**N.AfricaB**
Ecija_V	0.1796								
Granada CSC	0.5432	0.7765							
Granada LaT	0.4436	0.4932	0.1558						
Granada P	0.2148	0.2165	0.2795	0.07659					
Lucena C	0.2354	0.4006	0.2174	0.047149	0.0487				
Lucena RS	0.4398	0.4565	0.2369	0.0655	0.1014	0.061217			
Sevilla DJ	0.2774	0.3533	0.1324	0.006845	0.0816	0.048032	0.05935		
North AfricaB	0.5692	0.6037	0.502405	0.080837	0.1517	0.138284	0.119809	0.115952	
North AfricaAJ	1.053011	1.231118	0.784215	0.570603	0.610336	0.652892	0.589101	0.635426	0.419749

Table 8.22 presents the biological distances obtained from the scaled **R** matrix of the female dental metric samples. Overall, the pattern for the females is somewhat similar to the results for the male dental metric samples. Those samples from Écija and North Africa, overall, show greater distance from the remaining samples. The Jewish samples from Lucena and Sevilla show the smallest distances to each other. Of particular note, the females in the Pre-Islamic site of Cerro de San Cristobal, Granada, show a smaller distance to those of the North African Berber sample.

Table 8.22 Genetic distances derived from the scaled **R** matrix of the female dental metric samples.

	Ecija I	**Ecija V**	**Granada CSC**	**Granada LaT**	**Granada P**	**Lucena C**	**Lucena RS**	**Sevilla DJ**	**Sevilla T**	**N.Africa B**
Ecija_V	0.2422									
Granada CSC	0.2618	0.9710								
Granada LaT	0.4321	1.0111	0.1888							
Granada P	0.4797	1.1922	0.2456	0.104249						
LucenaC	0.3166	0.8809	0.1387	0.103129	0.128886					
LucenaR S	0.3286	0.8995	0.1167	0.040742	0.156566	0.14776				
SevillaDJ	0.2621	0.8320	0.1799	0.027043	0.03902	0.104112	0.064194			
SevillaT	0.1068	0.4813	0.000	0.0971	0.22337	0.064811	0.037494	0.095718		
North AfricaB	0.2821	0.9915	0.0405	0.201775	0.196366	0.160781	0.162299	0.165404	0.12751	
North AfricaAJ	0.4166	1.2281	0.15998	0.540599	0.556381	0.368522	0.507872	0.436599	0.26854	0.2354

Summary of Metric Results

When the results of the craniometric and dental metric analyses are considered together, several trends stand out in direct reference to the research questions and scenarios presented in this study. First, both data sets suggest a significant change in regional phenotypic variance through time in Andalucía, with variability increasing markedly from the Pre-Islamic period to the Early Islamic period. This increase plateaus, and even slightly decreases, between the Early Islamic period and the Late Islamic period. When this pattern is further explored, the Early Islamic period Islamic necropolis in Écija appears to be contributing greatly to the increase in phenotypic variability noted in this period. Of particular interest to interpretations of Early Islamic social dynamics, the results of the cranial and dental metric analyses suggest that males are contributing greater levels of phenotypic variability than females among these samples. The biological distance between Pre-Islamic Hispano-Roman females and Early-Islamic females is small, while the biological distance between Pre-Islamic Hispano-Roman males and Early-Islamic males is large. The distance between the North African Berber and Bedouin Arab samples and the Iberian samples remains fairly large throughout these time periods. These patterns will be explored further in Chapter 10 in comparison to those noted in the results of the nonmetric analyses, described in the next chapter.

CHAPTER 9

RESULTS—NONMETRIC DATA

This chapter presents the results of the statistical analyses for the nonmetric data described in detail in Chapter 7. Here, I review the results of the cranial and dental nonmetric analyses separately, concluding with a summary interpretation of the data as a whole. The metric data presented in Chapter 8 principally provide measures of changes in phenotypic variability through time, and the nonmetric data reviewed here provide results more closely examining potential biological divergence between these samples. That is, the statistical procedures employed here provide measures of changing patterns of biological affinities among Iberian and North African samples, between the sexes within these groups, and through time. A synthesis and discussion of the contextual interpretations of the metric and nonmetric results are presented in Chapter 10.

Cranial Nonmetric Analyses

In order to further address the research scenarios outlined in this dissertation and respond to the questions of changing biological affinities in southern Iberian through time, the cranial nonmetric data recorded for Iberian and North African samples are examined here using the C.A.B. Smith's Mean Measure of Divergence (MMD). Again, this method was selected principally for ease of comparison between the samples in this study and the Pre-Islamic North African Garamante data published by Nikita et al. (2010, 2012). A comparison to these samples will be made in the summary at the end of this chapter.

Biological Distance Between Samples

Using the Freeman and Tukey angular transformation correction and excluding variables with fewer than 10 observations (Harrisand Sjøvold 2003; Sjøvold 1977), I first calculated an MMD matrix for the cranial nonmetric data with the sexes pooled (Table 9.1). The individuals from Cerro de San Cristobal, Granada, were excluded from this analysis due to the small sample size. Statistically significant distances are noted in the matrix in bold. Negative values in an MMD matrix may indicate either a problematically small sample size, or may be converted to 0 for interpretation, as negative values could indicate that the biological distance between populations is very small (Harris and Sjøvold 2004; Irish 2006, 2010; Sutter and Verano, 2007). As sample size was accounted for prior to running the MMD, I interpret negative values here as indicative of very small biological distances between populations, though conservatively.

Table 9.1 Standardized Mean Measure of Divergence matrix for the cranial nonmetric samples with the sexes pooled. Values in bold represent statistically significant divergence.

	N Africa_AJ	**N Africa_B**	**Ecija_I**	**Granada_LaT**	**Granada_P**	**Lucena_C**	**Lucena_RS**
N Africa_AJ	0	0.007	**0.074**	0.036	0.039	0.012	**0.11**
N Africa_B	0.007	0	**0.172**	**0.039**	**0.098**	0.049	**0.204**
Ecija_I	0.074	0.172	0	**0.182**	-0.041	0.013	0.34
Granada_LaT	0.036	0.039	0.182	0	0.064	0.015	**0.167**
Granada_P	0.039	0.098	0.041	0.064	0	-0.025	0.026
Lucena_C	0.012	0.049	0.013	0.015	-0.025	0	-0.41
Lucena_RS	0.11	0.204	0.034	0.167	0.026	-0.041	0

When the divergence matrix presented in Table 9.1 is examined in the context of temporal divisions between populations, the results demonstrate the smallest distances occur among the Pre-Islamic samples (*e.g*. those from Purullena, Granada and Coracho, Lucena). Further, the Pre-Islamic Coracho sample from Lucena and the Early Islamic Ronda Sur sample from Lucena demonstrate some population affinity, as does the Pre-Islamic sample from Purullena and the Early Islamic sample from Écija. Also of note in this matrix is a statistically significant distance between the Early Islamic sample from Écija and the Late Islamic sample from La Torrecilla, Granada.

Multi-dimensional scaling (MDS) is used here to offer further visualization of these inter-sample phenetic differences (Figure 9.1).

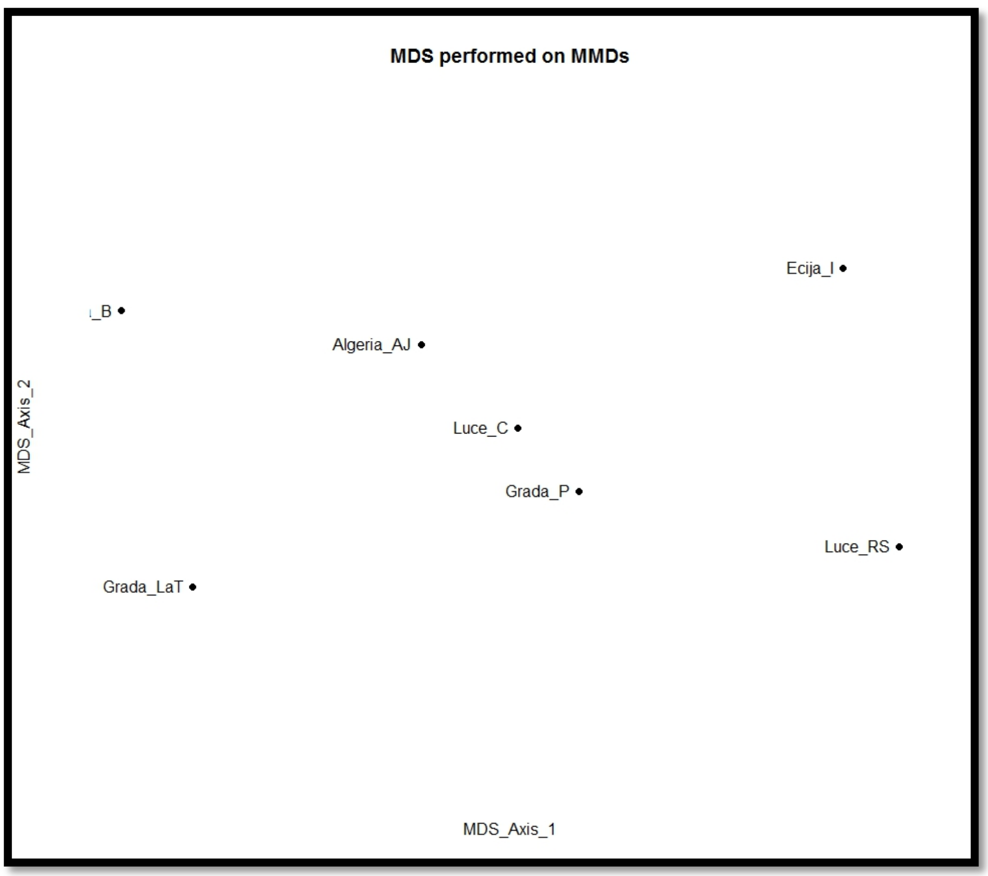

Figure 9.1 Multi-dimensional scaling of distance values for cranial nonmetric samples with sexes pooled.

The MMD matrix and the MDS plot demonstrate that with the sexes pooled the greatest distances appear to occur between the North African populations and those populations that comprise the Pre-Islamic and Early Islamic period Iberian samples. Thus, further analysis was undertaken to determine whether the source of this difference may be attributed to one or the other sex in the Early Islamic samples.

Identifying Possible Sources of Variability

When the sexes are considered separately in the calculation of an MMD matrix for the cranial nonmetric values, the issue of small sample size begins to affect the results. However, a few noteworthy results may be discussed. Table 9.2 presents the divergence matrix for the male cranial nonmetric samples. The results demonstrate a significant distance between the males in the Jewish sample from Ronda Sur and those of the North African samples and the Late Islamic period sample from La Torrecilla. This finding lends further weight to the suggestion of endogamy among Jewish and Islamic groups in southern Iberia in the transition from the Early to the Late Islamic period.

Further, Table 9.2 demonstrates a significant distance between the males in the Early Islamic Muslim sample from Écija and the Late Islamic Muslim sample from La Torrecilla. The metric data also demonstrated a lack of significant biological affinity between the Muslim samples in the transition between these periods. When the samples were pooled by sex and the phenotypic variability was examined though time, though, the metric analyses demonstrated lower-than-expected extra-local gene flow in the Late Islamic period. This trend is perhaps indicative of endogamy among Muslims from the conquest in the 8^{th} century to the Late Islamic period in the 12^{th} century.

Table 9.2 Standardized Mean Measure of Divergence matrix for the male cranial nonmetric samples. Values in bold represent statistically significant divergence.

	Algeria_AJ	**Algeria_B**	**Ecija_I**	**Granada_LaT**	**Granada_P**	**Lucena_C**	**Lucena_RS**
Algeria_AJ	0	-0.007	0.185	0.068	0.1	0.178	**0.293**
Algeria_B	-0.007	0	0.24	0.075	**0.185**	0.141	**0.472**
Ecija_I	0.185	0.24	0	**0.194**	-0.069	-0.041	0.116
Granada_LaT	0.068	0.075	0.194	0	0.099	0.061	**0.235**
Granada_P	0.1	0.185	-0.069	0.099	0	-0.305	-0.064
Lucena_C	0.178	0.141	-0.041	0.061	-0.305	0	-0.144
Lucena_RS	0.293	0.472	0.116	0.235	-0.064	-0.144	0

Presented in Table 9.3, the results of the MMD for the female cranial nonmetric data also demonstrate significant distances between females interred in the Early Islamic period site of Écija and those from the Late Islamic site La Torrecilla. Providing further clarification of the population affinities in the Early Islamic period, the results presented here demonstrate significant distances between North African females and those of the Early Islamic site Écija, and population affinities between these Early Islamic females and females from the Pre-Islamic samples included in analysis. These results further corroborate the suggestion that the majority of the females included in the Early Islamic mortuary program are not migrants, but are indigenous Iberian women.

Table 9.3 Standardized Mean Measure of Divergence matrix for the female cranial nonmetric samples. Values in bold represent statistically significant divergence.

	Algeria_AJ	Algeria_B	Écija_I	Granada_LaT	Granada_P	Lucena_RS
Algeria_AJ	0	-0.034	0.061	0.021	-0.019	-0.194
Algeria_B	-0.034	0	**0.114**	**0.047**	-0.032	-0.013
Écija_I	0.061	0.114	0	**0.083**	-0.074	-0.17
Granada_LaT	0.021	0.047	0.083	0	-0.096	-0.099
Granada_P	-0.019	-0.032	-0.074	-0.096	0	-0.211
Lucena_RS	-0.194	-0.013	-0.17	-0.099	-0.211	0

In order to ensure that small sample sizes are not affecting the overall interpretation of the results of the MMD analyses, and for better comparison to the results obtained for the metric data, further matrices were calculated examining sex differences in pooled groups separated by time period. When the sexes are pooled according to time

period, but otherwise considered separately in the calculation of an MMD matrix for the cranial nonmetric values, the cranial nonmetric data provide further information on the source of phenotypic variability noted in the Early Islamic period. Table 9.4 presents the divergence matrix for the male cranial nonmetric samples pooled by temporal period.

Table 9.4 Standardized Mean Measure of Divergence matrix for the male cranial nonmetric samples pooled by temporal period. Values in bold represent statistically significant divergence.

	Early Islamic	Late Islamic	North Africa	Pre Islamic
Early Islamic	0	**0.208**	**0.309**	0.190
Late Islamic	0.208	0	**0.121**	-0.005
North Africa	0.309	0.121	0	**0.161**
Pre Islamic	0.190	-0.005	0.161	0

When the male samples are pooled and separated by time period, the MMD matrix shows statistically significant distance between the Early Islamic period samples and the Late Islamic period samples. Further, the North African male samples are shown to maintain statistically significant distances from the samples in all Iberian temporal slices.

Table 9.5 demonstrates the results of the MMD matrix for the female samples separated by time period.

Table 9.5 Standardized Mean Measure of Divergence matrix for the female cranial nonmetric samples pooled by temporal period. Values in bold represent statistically significant divergence.

	Early Islamic	Late Islamic	North Africa	Pre Islamic
Early Islamic	0	**0.059**	**0.084**	0.002
Late Islamic	0.059	0	**0.065**	-0.053
North Africa	0.084	0.065	0	-0.021
Pre Islamic	0.002	-0.053	-0.021	0

The result of the MMD matrix for the female samples pooled by time period show a similar pattern to the males, with two interesting exceptions. Here, the matrix appears to suggest population affinity between the Pre-Islamic and Early Islamic females. Also, there is no statistically significant distance shown between Pre-Islamic and North African samples.

Results of Comparison to Published Data

When these results are compared to those obtained for other Iberian and North African samples, a few interesting observations can be made. As noted in previous chapters, Islamic period North African samples are unavailable for study currently. Published cranial nonmetric results from the Pre-Islamic North African Garamante sample are used here for comparison. Table 9.6 demonstrates the cranial nonmetric trait frequencies for the Iberian and North African samples included in this study, pooled by sex and separated by time period, for comparison to published trait frequencies for the Garamante samples (Nikita et al. 2012).

Table 9.6 Select cranial nonmetric trait frequencies for Iberian, North Africa samples, and Garamante samples.

Males	**Pre-Islamic**	**Early Islamic**	**Late Islamic**	**North Africa**	**Garamante**
Divided Infraorbital Foramina	0	3	2	0	30
Epipteric Bone	8	6	19	3	0
Hypoglossal Canal Bridging	7	6	14	3	0
Females					
Divided Infraorbital Foramina	0	2	2	0	12
Epipteric Bone	11	5	8	14	4
Ethmoidal Foramina	70	81	73	51	26.9
Maxillary Torus	20	11	19	13	0

In their 2012 publication, Nikita et al. report cranial nonmetric trait frequencies for the Garamante sample alongside trait frequencies for several other North African groups. They conclude that the Sahara Desert may have presented an effective barrier to gene flow between the Garamantes and other North and Northeast African groups, leaving the Garamante largely phenotypically isolated (Nikita et al. 2012). When these data are compared to the cranial nonmetric trait frequencies obtained for Iberian and North African samples, it is evident that this Pre-Islamic sample demonstrates closer affinity to the North African samples than to any of the Iberian samples. This affinity is relative, however, and Nikita et al.'s (2012) suggestion of Garamante population isolation appears to be further demonstrated here. Thus, the Garamante data do not provide a reference for the genetic variability noted in Iberia with the Islamic conquest and initial occupation.

Dental Nonmetric Analyses

To further explore the results obtained from the metric and cranial nonmetric analyses, the dental nonmetric data are examined here using the C.A.B. Smith's Mean Measure of Divergence (MMD). Again, though this method has faced valid criticism in recent years, it has remained popular and I employ it here principally for ease of comparison between the samples in this study and the North African data published by Irish (2000, 2010). A comparison to these samples will be made in the summary at the end of this chapter.

Using the Freeman and Tukey angular transformation correction and excluding variables with fewer than 10 observations (Harris and Sjøvold 2003; Sjøvold 1977), I calculated an MMD matrix for the dental nonmetric data with the sexes pooled (Table 9.7). As with the cranial nonmetric data, sample size was accounted for prior to running the MMD. Thus, I interpret negative values here as indicative of very small biological distances between populations, though conservatively. Those values demonstrating a statistically significant biological distance between populations are given in the table in bold.

Table 9.7 Standardized Mean Measure of Divergence matrix for the dental nonmetric samples with the sexes pooled. Values in bold represent statistically significant divergence.

	Algeria_B	**Ecija_I**	**Granada_CSC**	**Granada_LaT**	**Granada_P**	**Lucena_C**	**Lucena_RS**
Algeria_B	0	0.035	-0.019	0.002	-0.026	-0.013	**0.078**
Ecija_I	0.035	0	-0.011	**0.033**	0.023	**0.055**	**0.085**
Granada_CSC	-0.019	-0.011	0	0.006	0.011	-0.02	0.018
Granada_LaT	0.002	0.033	0.006	0	-0.004	0.021	**0.058**
Granada_P	-0.026	0.023	0.011	-0.004	0	0.039	**0.096**
Lucena_C	-0.013	0.055	-0.02	0.021	0.039	0	**0.051**
Lucena_RS	0.078	0.085	0.018	0.058	0.096	0.051	0

When the divergence matrix for the dental nonmetric data with the sexes pooled is examined in the context of temporal divisions between populations, the results are similar to those obtained for the pooled cranial nonmetric data. The matrix again demonstrates the smallest distances occurring among the Pre-Islamic samples (*e.g.* those from Purullena and Cerro de San Cristobal, Granada and Coracho, Lucena). Interestingly, the Pre-Islamic Visigothic Coracho sample from Lucena and the Early Islamic Jewish Ronda Sur sample from Lucena demonstrate significant biological distance in the dental nonmetric data. Further, it should be noted that the Jewish sample from Ronda Sur, Lucena, dated to the Early Islamic period, demonstrates statistically significant divergence from all but one of the samples included in the analysis. This finding adds weight to the argument that the Jewish community in Lucena remained endogamous throughout Islamic conquest, a scenario that will be explored in more detail in Chapter 10. As seen in the results from the cranial nonmetric analysis, there is a statistically significant distance between the Early Islamic Muslim sample from Écija and the Late Islamic Muslim sample from La Torrecilla, Granada.

Multi-dimensional scaling (MDS) is again used to offer further visualization of these inter-sample phenetic differences for the dental nonmetric data (Figure 9.2).

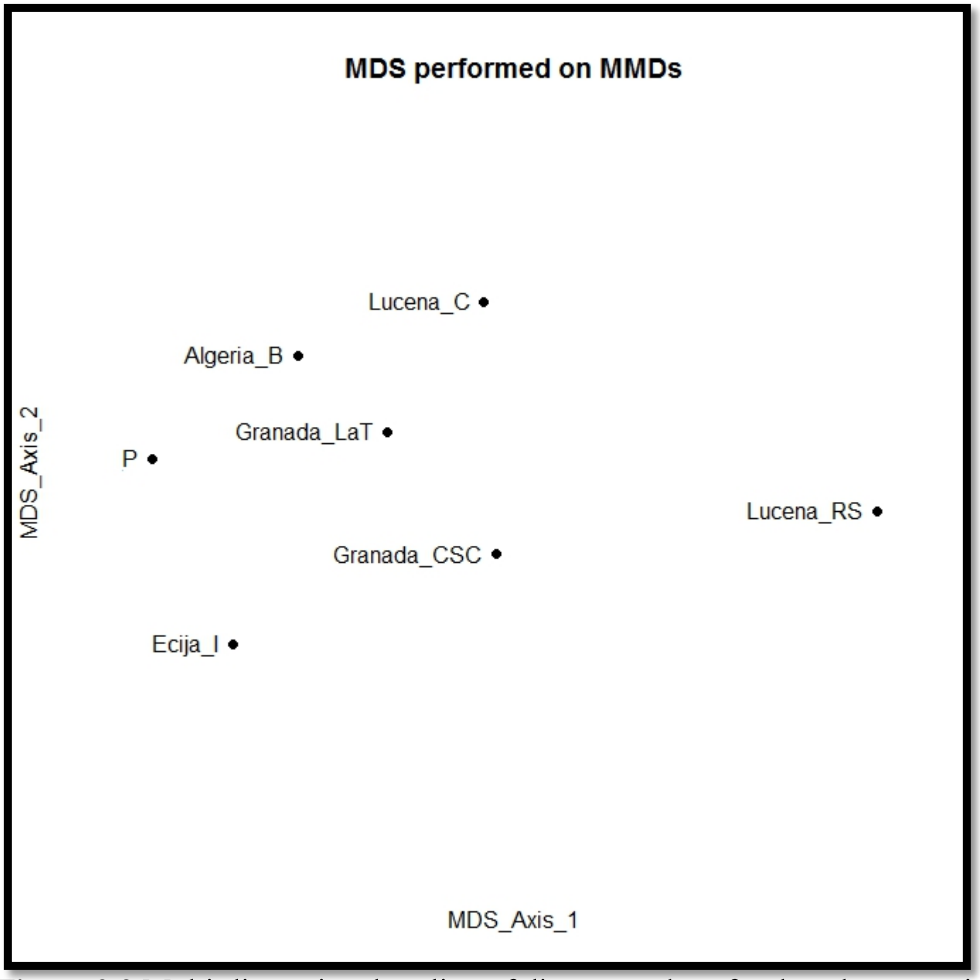

Figure 9.2 Multi-dimensional scaling of distance values for dental nonmetric samples with sexes pooled.

The MMD visually demonstrates the great distance between the Jewish sample from Ronda Sur, Lucena, and the remainder of the samples included in the analysis. The MMD matrix and the MDS plot also demonstrate that with the sexes pooled the greatest distances appear to occur between the Pre-Islamic and Early Islamic period Iberian samples. Thus, further analysis was undertaken to determine whether the source of this difference may be attributed to one or the other sex. In order to explore the possible influence of sex in these patterns through time in southern Iberia, further analysis is undertaken with the samples separated by sex in the following sections.

Identifying Possible Sources of Variability

When the sexes are considered separately in the calculation of an MMD matrix for the dental nonmetric values, it should be noted that the issue of small sample size again could be affecting the results. The males from the North African Arab and Jewish samples are removed from analysis due to small sample size. However, as with the cranial nonmetric data, a few noteworthy results may be discussed. Table 9.8 presents the divergence matrix for the male dental nonmetric samples. The results presented here demonstrate significant distance between the Early Islamic period males from the Muslim cemetery in Écija and the Early Islamic period males from the Jewish cemetery of Ronda Sur. There is also a significant distance between these males from Ronda Sur and the Late Islamic period males from the Islamic cemetery of La Torrecilla. This finding corroborates the results from the cranial nonmetric analysis suggesting maintenance of divergence between Jewish and Islamic males in the Islamic conquest and occupation of Iberia.

Table 9.8 Standardized Mean Measure of Divergence matrix for the male dental nonmetric samples. Values in bold represent statistically significant divergence.

	North Africa_B	**Ecija_I**	**Granada_CSC**	**Granada_LaT**	**Lucena_C**	**Lucena_RS**
North Africa_B	0	0.087	0.065	0.054	0.055	0.099
Ecija_I	0.087	0	0.142	0.01	0.046	**0.073**
Granada_CSC	0.065	0.142	0	0.117	0.087	0.147
Granada_LaT	0.054	0.01	0.117	0	0.033	**0.089**
Lucena_C	0.055	0.046	0.087	0.033	0	0.104
Lucena_RS	0.099	0.073	0.147	0.089	0.104	0

The results presented in the MMD matrix for the female dental nonmetric samples further demonstrate the consistent endogamy of the Jewish group from Ronda Sur (Table 9.9). These results also demonstrate a statistically significant distance between the North African Berber females and the Early Islamic period females buried in the Islamic cemetery in Écija, lending further weight to the suggestion that the females interred in Islamic style in this Early Islamic cemetery are not Berber migrants.

Table 9.9 Standardized Mean Measure of Divergence matrix for the female dental nonmetric samples. Values in bold represent statistically significant divergence.

	North Africa_B	Écija_I	Granada CSC	Granada LaT	Lucena C	Lucena RS
North Africa_B	0	**0.111**	0.145	**0.105**	0.105	**0.264**
Écija_I	0.111	0	0.072	**0.045**	**0.084**	**0.173**
Granada_CSC	0.145	0.072	0	**0.122**	**0.145**	**0.219**
Granada_LaT	0.105	0.045	0.122	0	**0.077**	**0.172**
Lucena_C	0.105	0.084	0.145	0.077	0	0.243
Lucena_RS	0.264	0.173	0.219	0.172	0.243	0

As with the cranial nonmetric data, by separating the samples according to sex and pooling the sexes into relevant time periods, I was able to construct an MMD matrix that more clearly demonstrates the differentiated contribution of the sexes to the patterned changes in biological diversity noted through time in southern Iberia. Table 9.9 presents the divergence matrix for the male dental nonmetric samples pooled by temporal period.

Table 9.10 Standardized Mean Measure of Divergence matrix for the male dental nonmetric samples pooled by temporal period. Values in bold represent statistically significant divergence.

	Early Islamic	Late Islamic	NorthAfrica	Pre Islamic
Early Islamic	0	**0.048**	**0.106**	**0.042**
Late Islamic	0.048	0	**0.071**	**0.042**
North Africa	0.106	0.071	0	**0.109**
Pre Islamic	0.042	0.042	0.109	0

The MMD matrix presented in Table 9.10 demonstrates statistically significant distances between males across all time periods. Contrary to the results obtained by constructing this matrix for the cranial nonmetric data, this finding does not appear to elucidate patterns in the results further than those obtained by separating the sexes for each site.

Table 9.11 demonstrates the results of the MMD matrix for the female samples separated by time period.

Table 9.11 Standardized Mean Measure of Divergence matrix for the female dental nonmetric samples pooled by temporal period. Values in bold represent statistically significant divergence.

	Early Islamic	**Late Islamic**	**NorthAfrica**	**Pre Islamic**
Early Islamic	0	0.031	**0.126**	0.041
Late Islamic	0.031	0	**0.096**	**0.104**
North Africa	0.126	0.096	0	**0.119**
Pre Islamic	0.041	0.104	0.119	0

This matrix demonstrates statistically significant distances between North African females and those dated to both the Early and Late Islamic period sites. No statistically significant distance was found between the Pre-Islamic and Early Islamic females.

Results of Comparison to Published Data

As with the cranial nonmetric data, the results obtained here were compared to those obtained for other North African samples. I examined the dental nonmetric trait frequencies for the Iberian samples included in this study, pooled by sex and separated by time period, as compared to published trait frequencies for other North African samples (Irish 2000). As noted previously, Islamic period North African samples are unavailable for study currently. Published dental nonmetric results from Pre-Islamic and Post-Islamic North African samples are used here for comparison. In his 2008 publication, Irish reports dental nonmetric trait frequencies for a variety of North African, Northeast African, and Sub-Saharan African samples in reference to questions of population continuity in North Africa. When these data are compared to the dental nonmetric trait frequencies obtained for Iberian samples, Irish's (2008) findings echo the results obtained here with the North African data included in this analysis. Further, the Northeast and Sub-Saharan African populations appear to not provide a reference for the genetic variability noted in Iberia with the Islamic conquest and initial occupation.

Summary of Nonmetric Results

Results of the statistical analysis of the cranial and dental nonmetric data collected from Iberian and North African samples included in this dissertation are reviewed in this chapter. When the results are considered together and in comparison to published nonmetric data sets, a few overarching trends stand out in reference to the research questions and scenarios posed in this dissertation. First, both the cranial and dental nonmetric data demonstrate population affinity among the Pre-Islamic Iberian samples in

southern Iberia. These affinities do not carry through to the Early Islamic period in male samples, though they do appear to remain to some extent among female samples. That is, particularly in the Early Islamic Muslim cemetery from Écija, the results demonstrate statistically significant biological distance between males from the Pre-Islamic samples and those interred in this site. In contrast, females interred in an Islamic style in Écija do not demonstrate statistically significant biological distance from the females in Pre-Islamic samples. Second, the MMD and MDS calculated here consistently demonstrate a great biological distance Jewish individuals interred in Ronda Sur and those individuals from all other sites included in this analysis. Finally, the nonmetric data consistently demonstrate a statistically significant distance between those individuals interred in the Early Islamic Muslim cemetery of Écija and those interred in the Late Islamic Muslim cemetery of La Torrecilla. Interestingly, the females from the site of La Torrecilla show some degree of population affinity with the North African Berber females. These trends, the ways in which they respond to the research scenarios and questions posted in this study, and their relationship to those trends revealed in the metric data are explored further in Chapter 10.

CHAPTER 10

DISCUSSION

In this chapter, I discuss the results of the statistical analyses performed on the cranial and dental metric and nonmetric data collected for this study in light of the historically and archaeologically informed research questions and scenarios outlined in Chapters 1 and 2. Here, I will consider each research scenario separately as I discuss the biological distance evidence that corresponds. The results of the analyses outlined in Chapters 8 and 9 will be discussed as a whole, paying close attention to the trends and patterns that are similar across data sets. Where appropriate in response to the research scenario being discussed, the results obtained from analyses of these data sets will be considered separately. I will conclude with a summary of these topics, highlighting those previously published data sets that are of particular interest in light of the results provided by this dissertation.

Scenario 1: Migration of Family Groups

The first research scenario and associated expectations outlined in this dissertation focuses upon establishing an answer to the baseline question in studies of the Islamization of Iberia following the Islamic Conquest: **To what degree did conversion, rather than migration, result in the sudden presence and increase of Islamic style burials in Iberia following conquest?** As detailed in Chapter 3, Guichard (1976, 1977) proposed that the sudden increase in Islamic presence in Iberia, including the sudden appearance of large Islamic cemeteries, could be attributed largely to the migration of family groups from North Africa following conquest. In order to examine this possibility,

phenotypic variance was examined through time for North African and Iberian samples. Neither the metric nor the nonmetric results obtained here support this theory of Islamization. Rather, the results demonstrate a high degree of divergence between the North African samples and the Early Islamic samples, suggesting that the migration of family groups cannot be invoked as an explanation for the sudden appearance of Islamic style burials in the peninsula in the first few centuries following conquest. However, the results of the metric and nonmetric analyses also reveal a large increase in phenotypic variability from the Pre-Islamic to the Early Islamic period, thus mass conversions of the Iberian population and resulting regional population continuity cannot be invoked as a simple explanation for the rapid spread of Islamic influence, either. While family group migration may be ruled out as an explanation for Islamization, further analyses were undertaken in attempts to determine the degree to which conversion, rather than migration, resulted in the rapid spread of Islamic influence.

Scenario 2: Early Conversions

Given that the data suggest that conversion, rather than migration, seems to play the larger role in the spread of Islamic influence in from the 8th century in Iberia, I will now address the proposed research question: **What was the timing of conversion/migration in the peninsula, specifically in southern Iberia?** Epalza (1992) proposed that most conversions to Islam in the Iberian Peninsula occurred shortly after the Muslim conquest. The results produced here support that theory, as both the metric and nonmetric data reveal significant changes in phenotypic variability between pre-conquest Iberian and early occupation Islamic samples. That is, those individuals buried

in Islamic-style mortuary programs in the few centuries following conquest demonstrate a significant increase in phenotypic variability in comparison to those Iberian individuals buried in pre-Islamic cemeteries in the peninsula. Further, this change in phenotypic variability then plateaus and even decreases in the transition from the Early Islamic period to the Late Islamic period.

To address the question, **were individuals in some religious or social groups more prone to conversion than others?** further analysis was undertaken in an attempt to determine whether population affinity may be observed between either the pre-conquest Christian or Jewish style burials and the early Islamic style burials, which I argued might indicate that one of these groups converted more readily in the early stages of Islamic rule. The results produced here do seem to indicate some conversion from these groups. For example, the unscaled metric results produced here do suggest some population affinity between the Hispano-Roman Christian sample of Coracho, Lucena, and the Islamic sample in Écija (Table 8.6; 0.0777). Jewish groups throughout the time periods in question demonstrated a significant divergence from those individuals buried in Islamic style, suggesting particular endogamy among those groups throughout Islamic occupation.

To explore the related question, **were segments of those groups (i.e. sex) more prone to conversion?** samples were separated by sex and re-examined. In the transition from the Pre-Islamic period to the Islamic period, the results presented here suggest that phenotypic variability increased significantly, even three-fold, among males in Andalucía in the Early Islamic period, while it only increased slightly among females. Further, the biological affinity between Pre-Islamic Iberian females and Early Iberian Islamic females

is marked. These results support the possibility that the conquerors came without family groups and took indigenous women as wives (and/or concubines) who were then included in the Islamic mortuary program, comprising the majority of this ‘swift conversion’ group (Glick 1979; Levi-Provencal 1967; Marin 2000; Shatzmiller 1996). In a return to the graphic presented in Chapter 2, it is apparent that the biological expectations and contextual interpretations of the results of this research suggest a trajectory that follows line 2a (Figure 10.1).

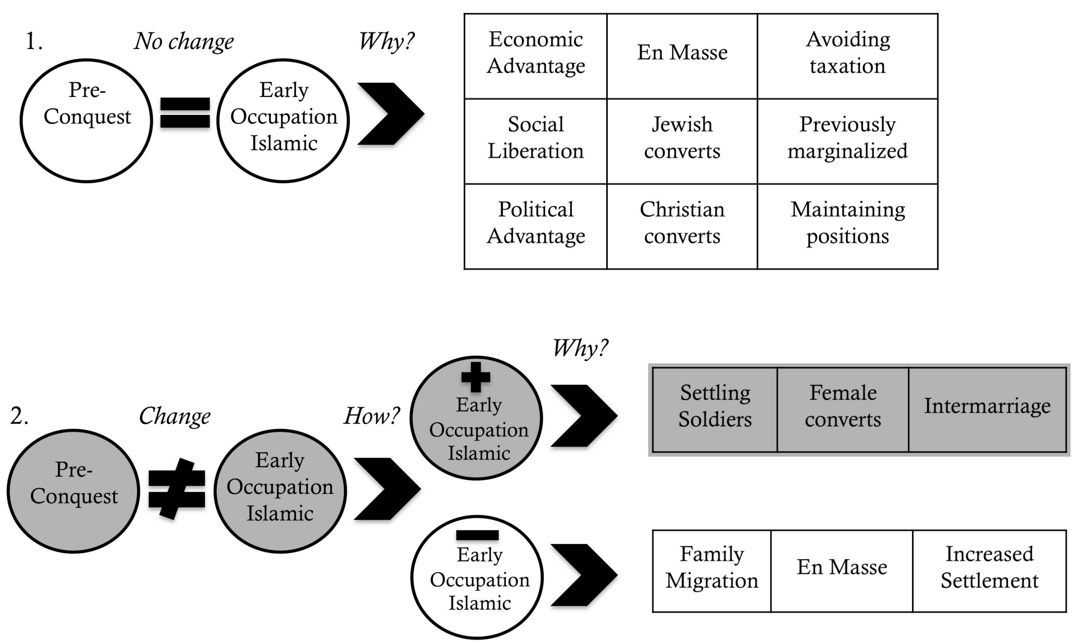

Figure 10.1 Biological results and contextual interpretations for *Scenario 2: Early Conversions*.

Scenario 3: Late Conversions

The third theoretical approach employed to frame the research questions and scenarios analyzed in this dissertation focuses upon the possibility of heightened conversion rates around the 12th century in Iberia. This temporal division is based upon Bulliet's (1979) 'peak of conversion' theory, as well as the possibility of mass conversions occurring during the stricter Almohad and Almoravid dynasties (Shatzmiller 1996). Again, this scenario returns to and addresses the research question, **what was the timing of conversion/migration in the peninsula, specifically in southern Iberia?**

The results of the analyses conducted for this dissertation do not support the theory that conversion was heightened from the 12th century through the end of the Islamic period. Rather, the results of the metric and nonmetric analyses reveal a stasis, and in some cases a slight decrease, in phenotypic variance in southern Iberia during this time. Overall, all data sets indicate below average extra-local gene flow in Andalucía during the Pre-Islamic period, greater than average extra-local gene flow in Andalucía during the Early Islamic period, and below average extra-local gene flow in the Late Islamic period. This trend lends further weight to the theory outlined in Scenario 2, suggesting that the peak of conversion/migration in the peninsula occurred in the first few centuries following conquest. While the population affinity noted between Berber females and Late Islamic females presents the interesting possibility that the Berber Almohad regime resulted in some migration from North Africa in later periods of occupation, overall for Andalucía the results indicate that endogamy among Islamic groups became more common through the 12th century (Figure 10.2). Further

contextualized exploration of this trend is required, and will be conducted in future iterations of this work.

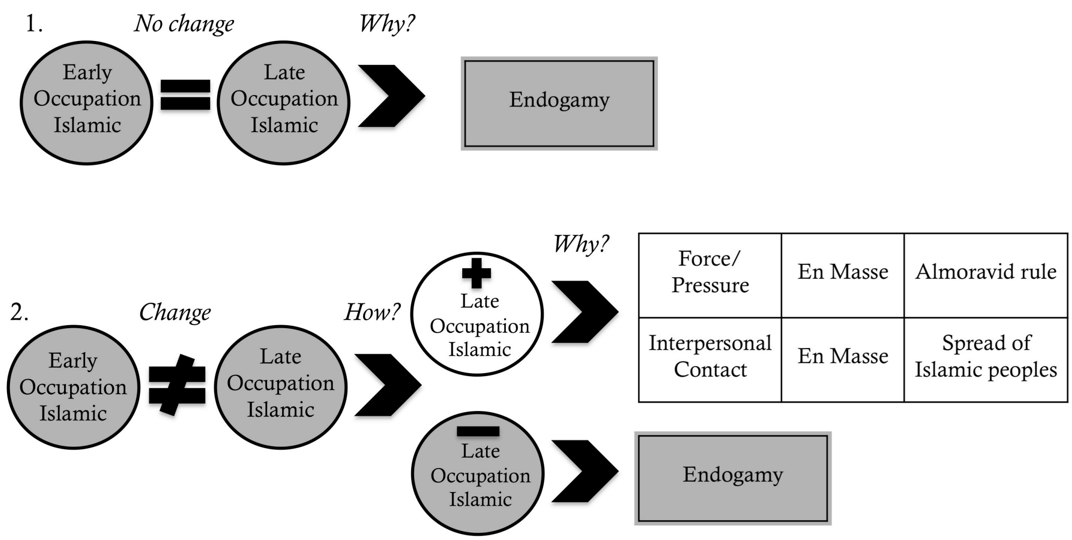

Figure 10.2 Biological results and contextual interpretations for *Scenario 3: Late Conversions*.

Conquest, Conversion, and Intermarriage

When the results of this study are examined in light of the research scenarios outlined above, a larger picture of interpersonal relations in southern Iberia before, during, and after Islamic conquest begins to emerge. In particular, these data allow us to address the research question, **What does the degree of genetic admixture and the mortuary patterning reveal about the population composition of Islamic Iberia**

following conquest? The biological distance data analyzed here suggest that migration of males and conversion of females, rather than migration of family groups, likely resulted in the sudden presence and increase in Islamic style burials in Iberia following conquest. Further, these data reveal that in southern Iberia, Hispano-Roman Christian women are more likely to be incorporated into the Early Islamic burial programs. In order to explore the contextual ramifications of these results, I return to the primary and secondary source documents for this period in an effort to interpret the biological data in light of their historical context and the theoretical models of social identity construction and religious conversion outlined in Chapters 3 and 4.

With the conquest of the Iberian peninsula in A.D. 711, archaeologists and historians note a sudden increase and spread of Islamic, architecture, place names, law codes, art, and, of particular interest here, burials. These signatures of conquest and settlement produce questions of attribution. That is, can we determine whether an influx of people or altered social identities among the conquered produced these material signatures of Islamic influence? The biological distance data presented in this dissertation indicate that some migration clearly occurred during Islamic conquest. Yet this biological signature of conquest does not fully explain the complexities of the spread of Islamic influence in this period. In order to further explore the mechanisms and characteristics of the changing social and religious identities and interactions in Islamic Iberia, the contextualized processes of conversion and intermarriage must be examined in further detail.

Religious conversion following Islamic conquest, whether true or nominal, chosen or 'forced', is assumed here to result in changing patterns of social affiliation.

That is, though social identity, and particularly religious identity, are assumed to be mutable, multi-dimensional, and involving cultural and social changes to varying degrees, conversion should result in altered patterns of affiliation that are notable, especially in mate choice and burial style. The biological data presented here suggest that social conversion to Islam, particularly by Iberian females, did occur in the first few centuries following conquest. Further, these data suggest that mate choice and funerary ritual became increasingly contained in Islamic groups as occupation continued through the centuries.

The results presented here, in which conquest brought cultural change, social conversion, and the strengthening of new social boundaries, allow for exploration of the dynamics of inter-faith reproduction and the inclusion of converted Iberian females into the mortuary program in this period. As reviewed in Chapter 4, Zorgati (2012) and Shatzmiller (1996) present evidence for the occurrence of inter-faith marriage in primary source legal documents, particularly *fatwās.* However, these texts cannot speak to the role or frequency of these social conversions in this period. In his 2015 monograph, Barton attempts to assign a role for intermarriage in this period by suggesting that inter-faith sexual relations between Muslim males and the indigenous Christian population following conquest may have provided an important mechanism for the consolidation of Islamic authority in the peninsula. The results here support the underlying thesis in Barton's (2015) work: that Muslim males appear to have frequently intermarried with Iberian Christian women following conquest. Muslim males and Christian females appear to comprise the majority of early Islamic style burials in southern Iberia. Further, it may be argued that reproduction occurring from these unions appears to account for the

consistent increase in Islamic style burials in the next few centuries, and that endogamy among Muslims then continued through the end of the period. However, it is important to note that the biological data presented here represent regional population affinities only in southern Iberia through time, and that further intracemetery analysis in Early Islamic groups is required to better elucidate more generalized interpretations. In this regard, I propose that expanded data collection and intra-cemetery analyses in the early Islamic cemetery of Écija, in particular, are necessary for further interpretations of the social dynamics and the role of intermarriage in this period.

Summary

Taken as a whole, the data analyzed for this study indicate a picture of conquest that brought an increase in phenotypic variability to the peninsula from the 8th-11th centuries. However, migration of family groups cannot be invoked as an explanation of the results presented here. Rather, the data indicate that males contributed the phenotypic variability to the samples in the Early Conquest period. Females, most frequently from Hispano-Roman Christian groups, appear to have intermarried with these early conquerors and possible with the *Muwallads*, male Islamic converts (Zorgati 2012). Further, Bulliet's (1979) conversion curve, which relies upon the assumption of innovation diffusion (i.e. conversion to Islam primarily was determined by level of exposure to Muslims), cannot be invoked to explain conversions to Islam in this period. Phenotypic variance remains in stasis or decreases in the period when the peak of this curve should have been noticed. Instead, the results presented here better support the

suggestion that conversion was a change brought on primarily by official stipulations, rather than by personal convictions (Christys 2002; Epalza 1992).

The identification and interpretation of religious identity in past populations is a particularly difficult challenge. When examining changes in religious identity, it is nearly impossible to address the question of nominal versus true conversion, and this research does not attempt to do so. Rather, the data collected and analyzed for this dissertation demonstrate the fluidity of social identities, particularly in times of increased culture contact and exchange. While in many ways conversion to Islam involved the adoption of new social practices, such as altered burial customs, the adoption of Islamic social practices should not be confused with the adoption of the Arabic language or Berber agricultural methods. Religious and ethnic identities are intertwined in a complicated fashion in this period, yet they remain distinct facets of social identity. In an era of conflict and war based largely on clashes between social and religious groups, the opportunity to examine past interactions among these groups, particularly the ways in which individuals confronted migration and changing social boundaries, offers new possibilities for the development of greater cross-cultural understanding.

CHAPTER 11

CONCLUSIONS

Though the issues of conversion and intermarriage may seem minor in the grand picture of the Islamic conquest and rule of Iberia, in many ways these social structures are key to a contextually specific understanding of the negotiation of religious and ethnic identity. A better understanding of population structure and intermarriage among religious and ethnic groups in Islamic Iberia sheds light on questions of acculturation in general, and on the debate regarding the balance of migration versus conversion in the peninsula.

Implications for Bioarchaeological Research in Iberia

This dissertation demonstrates that biological distance analysis can be used to reconstruct population history in the Iberian Peninsula, particularly in the Medieval period. By addressing the contested social interactions of the Islamic conquest of Iberia through biological data, this research provides an objective measure by which to evaluate historical interpretations of the interactions of religious groups from the 8th-14th centuries in southern Iberia. This study demonstrates that social conversion to Islam by female Hispano-Roman Christian Iberians occurred in concert with the settling of occupying forces of Islamic males, and that these Iberian individuals were included in the Islamic mortuary programs that appear in Andalucía shortly after conquest. (As stated in previous chapters, this inclusion of indigenous women into the Islamic mortuary program can be variably attributed to intermarriage, the taking of concubines, and slavery. The cause, nature, and personal attributes of this social conversion are beyond the scope of this

research, but provide interesting avenues for further study). This research also appears to confirm the historically informed assumption that offspring of these inter-faith unions would continue to be included in the Islamic mortuary program, and that endogamy among Muslims in Iberia then persisted throughout the remainder of Islamic rule. Endogamy in the Jewish community of Ronda Sur, Lucena, during the Islamic occupation is also demonstrated with statistical significance.

These results demonstrate the importance of contextualized bioarchaeological research in addressing research questions that are theoretically and historically informed. The odontometric data set collected for these samples is the first of its kind to be published for Spanish materials, illustrating the utility of this method for Iberian samples. While the focus of this dissertation was to address research scenarios and questions at an inter-site level, the results of this project call for future expansions of this research into questions of intra-cemetery population structure, particularly in those Early Islamic cemeteries where phenotypic variability is seen to increase significantly.

Broader Impacts and Intellectual Merits

Recently, practitioners of the social sciences have been challenged by the public to demonstrate the applicability of their research to today's global world. The results of this project contribute to the development of a deep time perspective and richer understanding of the dynamics of social interaction in the contexts of migration and conflict. Further, this dissertation contributes a novel framework and methodology to this developing body of research. While bioarchaeological research has advanced anthropological understandings of gender and age identities, religious identity remains an

under-explored topic. This research contributes to the development of a bioarchaeological approach to religious identity and conversion and directly responds to recent archaeological and historical calls for further exploration of religious and gender identities in the past (Green 2008; Joyce 2012). The results of this study contribute a novel context to studies of conversion, as this topic is often examined within the context of colonization in the Age of European Imperialism (Lindenfeld and Richardson 2012).

Though recent research has begun to produce general interpretations of population composition, activity, and health in Islamic Iberia, issues of migration and conversion have not yet been confronted through bioarchaeological analysis and comparison of Iberian and North African dental samples. The results of this study provide crucial context for the social changes resulting from the Islamic conquest and occupation. By utilizing microevolutionary and social theory in the examination of historical experiences that affect human biology, this project advances the integration and application of research methods from specialized fields in the pursuit of anthropologically driven questions. Further, this research directly responds to recent archaeological and historical calls for further exploration of religious and gendered identities in the past through an examination of conversion in this period. This dissertation expands the scope of bioarchaeological research through the development of an approach to religious identity and conversion, encouraging the engagement of sociological models of contact and conversion in such approaches.

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